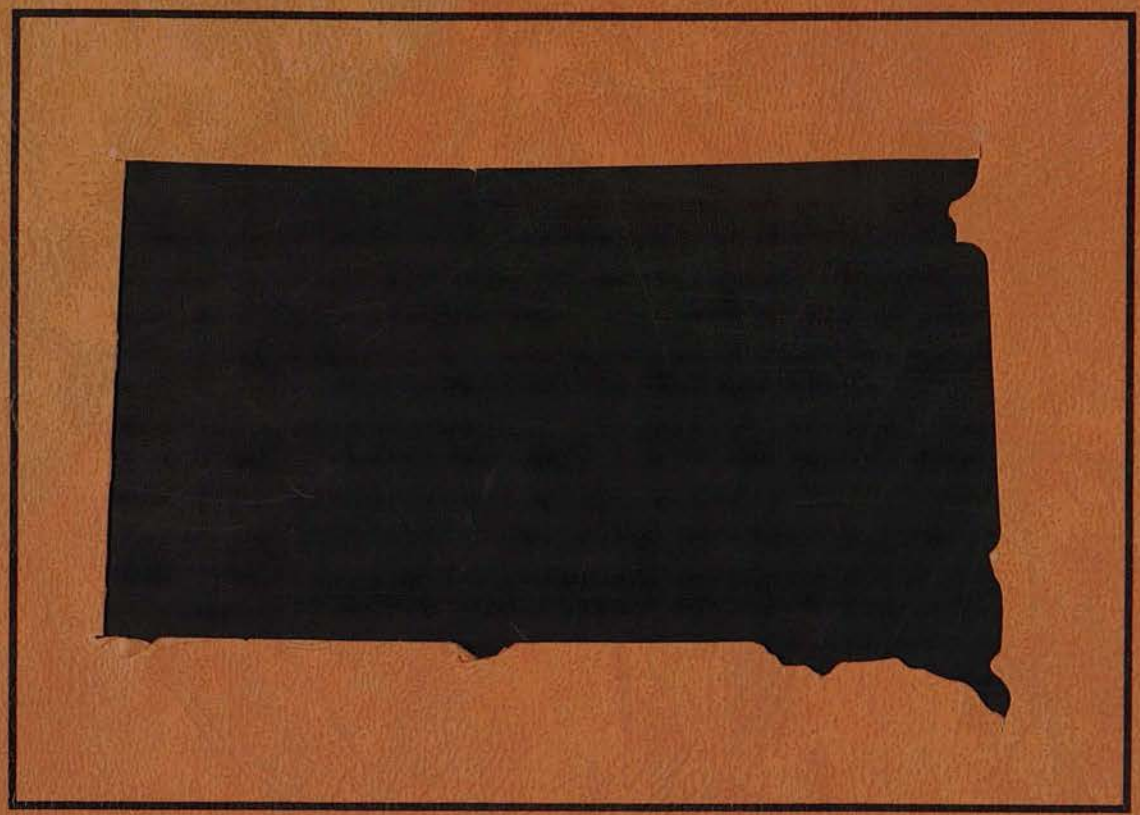

ECONOMICS DEPARTMENT

South Dakota State University
Brookings, South Dakota

CROP AND LIVESTOCK ENTERPRISES, RISK EVALUATION, AND MANAGEMENT STRATEGIES ON SOUTH DAKOTA SUSTAINABLE FARMS

by

Donald C. Taylor, Thomas L. Dobbs,
David L.Becker, and James D. Smolik*

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*Taylor and Dobbs are Professors of Agricultural Economics, Becker is a Research Assistant in the Department of Economics, and Smolik is a Professor in the Plant Science Department, all at SDSU, Brookings, S.D.

PREFACE

This report contains findings from on-farm interviews conducted during early 1989 with 22 sustainable farmers in South Dakota. The interviews constitute part of a study supported by Grant No. 88-56 from the Northwest Area Foundation (NWAF) and by the South Dakota State University (SDSU) Agricultural Experiment Station. The farm policy findings from the on-farm interviews are covered in SDSU Economics Staff Paper 89-7, Farm Program Participation and Policy Perspectives of Sustainable Farmers in South Dakota, October 1989.

Whole-farm economic analyses with data collected in some of the interviews are presently being undertaken under Phase II of the NWAF-supported study. Results of those analyses will be contained in future reports.

We appreciate the helpful comments to an earlier version of this report by Don Boggs, Range and Animal Sciences Department; Diane Rickerl, Plant Science Department; and Richard Shane, Economics Department. We, however, are responsible for any remaining errors of fact or interpretation in the report.

DCT, TLD, DLB, AND JDS

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Table of Contents

Summary and conclusions 1

Introduction 7

Sustainable farm locations 8

Sustainable farm families 8

Sustainable crop rotations 10

- Characterization of sustainable crop rotations 11
- Cultural operations 14

Livestock enterprises 17

- Nature of enterprises 17
- Sustainable management practices 18
- Feeds used 19
- Manure management 20

Risk evaluation 21

- Relative risks with sustainable versus conventional farming practices 21
- Comparative sustainable and conventional yields under contrasting production conditions 23
- Risk protection 26

Managerial strategies for meeting selected challenges of sustainable agriculture 27

- Transition weed problems 27
- Transition nitrogen shortages 28
- Finding markets for sustainably-raised products 29
- Improving the development and dissemination of quality information on sustainable agriculture 30
- Farmers better or worse off from following sustainable practices? . 32

References cited 33

Figure 1. South Dakota map, regional location of the 22 personally interviewed sustainable farmers 34

LIST OF TABLES

Table 1. Ages of boys and girls living at home, sustainable farms 35

Table 2. Selected features of sustainable crop rotations, by region 36

Table 3. Selected cultural operations for major crops included in sustainable rotations 38

Table 4. Numbers and sizes of livestock operations, sustainable farms .. 39

Table 5. Numbers of beef cows and calves, sustainable farms 39

Table 6. Roughages fed to beef cows, sustainable farms 39

Table 7. Percentage of cropland, over the period of a crop rotation, that receives manure applications, sustainable farms 40

Table 8. Sustainable farmer judgments on "best," "most normal," and "worst" crop production years 40

Table 9. Sustainable farmer judgments on sustainable versus conventional corn and soybean yields, by crop growing condition and region, 1984-1988 41

Table 10. Sustainable farmer judgments on sustainable versus conventional oat and spring wheat yields, by crop growing condition and region, 1984-1988 42

Table 11. Sustainable farmer judgments on sustainable versus conventional alfalfa yields, by crop growing condition and region, 1984-1988 42

Table 12. Crop insurance practices, sustainable farmers 43

Table 13. Sources of information to farmers about sustainable agriculture 44

LIST OF ANNEXES

Annex 1. Personal interview two-part questionnaire 45

Annex 2. Sustainable crop rotation components and management practices . 52

Annex 3. Cultural operations followed in sustainable crop rotations 59

Annex 4. Sustainable livestock management practices 82

Annex 5. Advice of sustainable farmers on how to deal with transition weed problems 84

Annex 6. Advice of sustainable farmers on how to deal with transition nitrogen shortages 86

Annex 7. Sustainable farmer judgments on shortcomings in organic product marketing 88

Annex 8. Sustainable farmer judgments about potential issues for research on sustainable agriculture 91

Annex 9. Sustainable farmer suggestions on cooperative working relationships among farmers, private organizations, and universities concerning sustainable agriculture 94

Annex 10. Sustainable farmers better or worse from following sustainable practices? 96

SUMMARY AND CONCLUSIONS

This report presents findings from personal interviews undertaken in January-March 1989 with 22 of the 32 sustainable/regenerative farmers in South Dakota who responded to a Summer 1988 mail survey concerning their sustainable farming practices. [For the mail survey results, see Taylor, Dobbs, and Smolik, 1989.] The major purpose of the personal interview part of the study reported herein was to gain greater insight into (1) the sustainable crop rotations and livestock enterprises on the respondents' farms and (2) farmers' judgments about managing (a) risk and (b) other special aspects associated with sustainable agriculture. The most important findings in the report are summarized below.

1. Information on the "organic purity" of the 22 farmers is as follows. Ten are "totally crop organic" from the standpoint that they use no synthetic chemical fertilizers and pesticides on any of their cropland. Five have "organic" crop rotations, but also have some cropland on which some synthetic chemicals are used. Seven use reduced levels of synthetic chemicals on their crops, but are yet to completely eliminate the use of chemicals on any of their cropland.

2. At least one small grain is found in all crop rotations. The most common small grain is oats (in 68% of the rotations), followed by spring wheat (50%), rye (46%), and millet (32%).

3. At least one row crop is found in 20 of the 22 rotations, with soybeans (77% of the rotations) and corn (66%) being the most common row crops.

4. Seventeen rotations have alfalfa and one red clover. Alfalfa is most commonly left down, after establishment, for 4-5 years (8 rotations). Four farmers leave alfalfa for 2-3 years, 2 for 6-7 years, and 2 for 1 year. The 2 farmers who leave alfalfa for only 1 year after establishment do so to minimize alfalfa's impact on soil moisture depletion and maximize alfalfa's impact on weed control.

5. Twelve rotations involve at least 1 year of summer fallowing. A cover crop (most commonly sweet clover, but sometimes forage sudan) is used by 7 farmers and black summer fallow by 5.

6. A "first-cut" typological description of South Dakota's sustainable crop agriculture, in terms of the four regions denoted in Figure 1, is as follows.

South Central Region

- Relatively small cropland acreages (average of 425 for the 7 surveyed farms).

- Rotations relatively balanced between small grains and row crops, with a definite presence of harvested forage legumes.

- Limited summer fallowing with cover crops (2 of 7).

East Central Region

- Relatively small cropland acreages (average of 535).

- Relatively non-complex rotations, with a rather definite orientation to a pattern of Soybeans - Corn - Small Grain - Forage Legume.

- Row crops slightly more prominent than in the South Central Region, and far more important than in the West.

- Harvested legume forages slightly more prominent than in the South Central Region; alfalfa harvested for fewer years than in other regions.

- Relatively limited cover crop summer fallowing.

Northeast Region

- Intermediate cropland acreages (average of 760).

- Small Grain - Summer Fallow a fundamental component of rotations; soybeans also present in all studied rotations.

- Extent and diversity of small grains greater than in other regions, e.g., 80% of the farms have each of spring or winter wheat, rye, and millet.

- Black summer fallowing common (60% of rotations).

- Forage legumes less important than in the South Central and East Central regions.

West Region

- Large cropland acreages (average of 1,500).

- Small Grain - Summer Fallow a fundamental component of rotations.

- More intensive (frequent) fallowing than in other regions, e.g., 67% of rotations have black fallowing.

- Row crops of almost zero importance.

7. From pre-plant land preparation through the post-harvest period, an average of 9 cultural operations is performed on both corn and soybeans. This includes averages of 2.7-2.8 field tillage and 3.9 weed control operations per year per crop. Fifteen of the 16 farmers with both corn and soybeans cultivate for weed control. From 2 to 3 cultivations per season are most common for corn; 2 cultivations are most common for soybeans. The second most common type of mechanical cultivation with corn and soybeans is the rotary hoe.

8. Averages of between 5.9 (for winter wheat) and 7.9 (oats) cultural operations per year are performed with the main small grains. Row crops

involve about the same numbers of field tillage operations as small grains, but fewer weed control operations.

9. The moldboard plow is used by only 10 farmers. These farmers all use the plow to incorporate alfalfa or sweet clover. Two also use the plow following small grain, and one following the application of an organic soil conditioner on soybean ground.

10. Eighteen of 21 farmers have commercial livestock enterprises. The most common type of livestock involves beef cow-calf operations; next is cattle finishing. Herd sizes on the sustainable farms average only about one-half the State average of 79 cows per farm. Less than one-fourth of the farms have hog farrowing, hog finishing, or dairy enterprises.

11. Fourteen of the 18 farmers with livestock consider themselves to raise their livestock sustainably, 2 follow a combination of sustainable and conventional practices, and 2 do not follow sustainable practices. Livestock management practices viewed as "sustainable" by a majority of farmers are:

a. The feeding of only organically grown grain and roughage to livestock;

b. A greater reliance on roughages relative to grains in finishing cattle; and

c. The non-use of (i) antibiotics and other additives in concentrate feeds, (ii) hormones and other growth stimulant/promotants, (iii) insecticides, (iv) vaccinations of animals, and (v) closed confinement facilities.

12. All 18 farmers with livestock report using all the manure they produce on their farms. Two also obtain manure from neighbors. Nevertheless, manure applications to cropland appear to be limited. For example, 6 farmers report covering 5% or less of their cropland once with manure--over the period of their respective crop rotations. Three farmers apply manure to between 6% and 20% of their cropland. The crop rotations on these 9 farms range in length from 5 to 10 years. The 3 farmers who make the heaviest manure applications cover the following percentages of their cropland once each 3 years: 30%, 50%, and 60-75%.

13. Eleven of 21 farmers perceive sustainable agriculture to involve less risk than conventional agriculture, 3 more risk, 2 both more and less risk, and 5 no difference.

14. Sustainable agriculture may be more risky than conventional agriculture from several standpoints.

a. Since the transition from conventional to sustainable farming involves a general venture into the "unknown," risks can inevitably be expected to increase, specifically with regard to problems such as (a) expanded weed and other pest pressures and (b) nitrogen shortages.

b. Since Federal farm programs do not exist for legume forages and most livestock products integral to many sustainable farm operations, informal "government price guarantees" that can be enjoyed by grain farmers who participate in the Federal farm program are not realizable to the same extent by sustainable farmers.

c. Since "organic" product markets are thin, the risks of organic product price instability are greater.

d. Since wholesale organic product buyers generally do not purchase and take possession of organic produce from farmers until the buyers have found markets for the produce, expanded risks of cash-flow problems may be experienced by sustainable producers.

e. Since some lenders do not believe in sustainable agriculture, risks of farmers being unable to secure even modest amounts of credit may increase.

f. Since sustainable farmers may sometimes experience personal ridicule from the local community and even threatening actions by conventional farmers, risks of physical, mental, and emotional health impairment for them may increase.

15. On the other hand, risks with sustainable agriculture can be less than with conventional agriculture from several standpoints.

a. Since sustainable farmers have their enterprise "eggs in more than one basket," they experience less risk from potentially (a) adverse field growing conditions and (b) adverse product price movements.

b. Since sustainable farmers commonly have livestock that can make constructive use of relatively low value feedstuffs, they incur less risk of economic disaster when crops fail.

c. Since sustainable farmers purchase fewer off-farm inputs than their conventional counterparts, risks are less of their (a) being unable to meet creditor obligations and (b) experiencing expanded production expenses when input price movements are adverse.

d. Since soil managed sustainably has improved structure and organic matter content and hence an enhanced soil water-holding capacity, sustainable farmers have less risk of experiencing (a) production disaster during drought and (b) exaggerated soil erosion during rainfall downpours.

e. Since sustainable farm workers handle fewer or no potentially dangerous chemicals, risks of health impairment to them are less.

f. Since synthetic chemical input use is less with sustainable agriculture, risks of ground and surface water contamination and health impairment to diet-sensitive consumers may be less.

g. Since the managerial requirements of sustainable agriculture are great, special positive incentives exist for sustainable farmers to become

even stronger managers, thereby resulting in their becoming better able to cope with risks and uncertainties.

16. Sustainable farmers indicate mixed judgments on relative crop yields with sustainable versus conventional practices under "normal" production conditions. Nevertheless, for all crops, a larger number believe sustainable yields to be less.

17. During years of unusually favorable production conditions, corn farmers generally indicate a relative loss in sustainable versus conventional yields, i.e., a widened gap between sustainable and conventional yields. During years of unusually unfavorable production conditions, on the other hand, they indicate a relative gain in sustainable versus conventional corn yields--to the point where the sustainable versus conventional yield deficit is reduced or sustainable yields become greater than conventional yields. These findings are consistent with those reported in the literature. For soybeans, oats, and spring wheat, however, farmers' yield judgments on relative yield changes hold up more strongly on (a) the relative upside potential for sustainable practices with unfavorable production conditions versus (b) the relative downside potential with unusually favorable conditions.

18. Farmers indicate yield differences for crops grown under sustainable versus conventional farming practices to be greatest for row crops (corn and soybeans), intermediate for small grains (oats and spring wheat), and least for alfalfa. The latter is generally expected since conventional farmers commonly use relatively few synthetic chemicals in producing alfalfa.

19. The most important method to control weeds during the transition from conventional to sustainable practices is implementing crop rotations to interrupt the growth cycles of individual weed species. Including forage legumes and weed competitive crops (e.g., rye, millet, buckwheat) in the rotations contributes to effective weed control. The second and third most important weed control methods are mechanical cultivation and special timeliness of crop planting and cultivation.

20. The most important means of overcoming transitional nitrogen shortages is also crop rotations. In this instance, the presence in rotations of (a) legumes for nitrogen fixation and (b) cover crops and plant residues for plow-down are crucial.

21. The most common problem in marketing organic products reported by the farmers arises from wholesale buyers not purchasing and taking possession of organic produce from farmers until the buyers have found markets for the produce. As a result, a producer has to bear the burdens of (a) providing and meeting associated costs of on-farm storage for the organic produce and (b) an uncertain and uneven cash-flow over time. A second rather commonly cited problem with marketing organic produce concerns the distance from producers to plants where the organic produce is cleaned and assembled for shipping.

22. The most commonly suggested sustainable agriculture issue meriting attention in research is the comparative testing of sustainable and

conventional crop rotations. Suggested focal points for emphasis in such work are soil fertility, soil structure, soil microbial activity, and weed control.

23. The most common thread in responses of farmers on how they, private organizations, and universities can work most effectively with each other is that "everyone" remain open-minded about agriculture and not automatically assume that any one way is necessarily better or worse than another. Sustainable agriculture should be covered in the research, extension, and teaching functions of the university, rather than be dismissed as an alternative totally devoid of possible merit.

CROP AND LIVESTOCK ENTERPRISES, RISK EVALUATION, AND MANAGEMENT STRATEGIES ON SOUTH DAKOTA SUSTAINABLE FARMS

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INTRODUCTION

In April 1989, the findings from a Summer 1988 mail survey of 32 sustainable/regenerative farmers in South Dakota were published (Taylor, Dobbs, and Smolik, 1989). The present report is based on more in-depth personal interviewing in January-March 1989 of 22 of those 32 farmers.[1]

The purpose of the interviews was to gain greater insight into (1) who the sustainable farmers are, (2) their crop rotations, (3) their livestock enterprises, (4) their judgments on the relative riskiness of sustainable versus conventional farming, (5) their participation in and views about government farm programs, and (6) managerial strategies for overcoming critical problems with sustainable agriculture. This report covers the personal interview survey findings except for those concerning government farm programs that are reported in Dobbs, Becker, and Taylor (1989).[2]

Farmers indicating a willingness to be personally interviewed, in the earlier mail survey, were considered for possible inclusion in the personal interview survey. A further condition for inclusion in the personal interview survey was that a farmer be beyond--or at least well into--the transition from "conventional" to "sustainable" farming practices. Resulting from the application of these 2 criteria was the selection of 20 farmers. To widen modestly the personal interview coverage, 2 farmers who had been invited to complete the Summer 1988 mail survey, but who had been unable to do so, were also contacted; they agreed to participate in the personal interviews.

A 2-part questionnaire was used with the "personal" interviews (see Annex 1). Part I was sent in the mail to each respondent, with a request that the respondent complete as much of it as possible in advance of a later-to-be-scheduled visit of the personal interviewer, David L. Becker. At the time of Becker's visit to the individual farmers, he reviewed Part I to clarify any responses that were unclear and attended to any portions of Part I not yet completed. Most of Becker's personal interview time, however, was spent in soliciting the rather detailed information requested in Part II.

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[1]Additional insights were gained during Summer 1989 when various members of SDSU's sustainable agriculture research team visited several of the farmers who had been interviewed earlier in the winter.

[2]The survey findings for 12 of the farms are also being used in the development of detailed cost-return budgets for major individual farm enterprises and crop rotations. These budgets will then be used in whole farm economic analyses under Phase II of the NWAF research project.

One of the personally interviewed farmers was unable to complete Part I of the questionnaire. Thus, the results reported herein are based on 21 Part I and 22 Part II responses.

SUSTAINABLE FARM LOCATIONS

In the Summer 1988 mail survey study, the sustainable farmer respondents were described as being in 1 of 3 regional locations in South Dakota: the Southeast, Northeast, and West. In this report, the latter 2 regional identities are retained. Farmers in the southeastern part of the State, however, were reclassified as being in either the "South Central" or "East Central" region. The reclassification was undertaken because of a certain rather distinctive micro-clustering of the personally interviewed farmers in these 2 sub-areas of the "Southeast" and a certain differentiation in the nature of the sustainable crop rotations in these 2 areas.

Figure 1 shows the location of the 22 personally interviewed sustainable farmers. The following numbers of farmers are from each region: South Central - 7, East Central - 7, Northeast - 5, and West - 3. The farms within the first 3 regions have a more well-defined regional identity than those within the fourth. The 3 farms in the West are located so far from one another and represent such a tiny part of the West that they can more appropriately be viewed as 3 case farms in western South Dakota. To simplify the text, however, they are described as being located in the "West," the same as the farms in each of the other regions.

SUSTAINABLE FARM FAMILIES

The size of family for the farmers interviewed--defined to include those considered part of households for living expense and tax purposes--ranges from 1 to 8 and averages 4.10. The families include averages per family of 1.25 sons and 0.85 daughters of the age ranges shown in Table 1. A larger percentage of girls (76%) than boys (48%) exceeds 10 years of age.

Twenty of the 22 farms are organized as sole proprietorships, with one being a rather informal partnership. The other 2 farms are family corporations. These proportions are roughly consistent with those for all farms in South Dakota: 87% - sole proprietorships, 9% - partnerships, 3% - corporations, and 1% - other (USDC, 1989, 7).

Twelve of the 22 farmers use operator and family labor to perform all the work on their farms. Nine accomplish between 90% and 99% of the work on their farms with themselves and their families. Only one relies on family for less than 90% of his total labor needs (75-85% in this case). The most common type of hired labor is for hand weeding soybeans (and also, for one farmer, weeding sunflowers), followed by picking up rocks in fields. Other specific tasks for which labor may be hired are for fence building, carpentry for fixing up buildings, pre-planting field work, baling, and farm chores.

The managerial decision-makers on the 22 farms are as follows:

- 7 husbands;

- 5 husbands and wives jointly;

- 2 brothers jointly;

- 2 single farmers;

- 2 sons, in consultation with fathers;

- 1 husband, wife, and son jointly;

- 1 husband, in consultation with wife;

- 1 husband, in consultation with wife and father; and

- 1 husband, in consultation with wife and son.

Thus, husbands clearly are the dominant decision-makers, but their wives and other family members in many cases either participate jointly or play supportive roles in the decision-making.

Seven of the 22 farmers perform custom work for others. Baling and combining are most common. One farmer also does each of the following: sharpening discs and welding, planting, windrowing, and trucking. Two farmers spend between 20 and 30 days annually performing custom work for others; one 10 days; and the others 2-4 days each.

Fifteen of the 22 farmers have custom work done for them. The incidences of different types of custom work are as follows:

- 7 combining;

- 4 planting;

- 3 each of fertilizer/chemical application, baling/stacking/hauling, and grain hauling; and

- 1 hay grinding.

For 11 farms, no more than 5 days each are involved annually with this custom work. For the other 4 farms, between 6 and 10 days are involved.

Ten of the 22 farmers derive 100% of their adjusted gross income exclusively from the farm. Six derive 80-99% of their adjusted gross farm income from the farm, two 60-79%, one 40-59%, two 20-39%, and one did not answer. On all farms with off-farm income except one (in which stocks, bonds, and other investments account for 20% of adjusted gross income), off-farm employment is the dominant alternate source of income.

Of the 12 instances of off-farm employment by the operator and/or his family, 4 involve the husband only, 4 the wife only, 3 both the husband and wife, and 1 both the father and son. Thus, 36% of the sustainable farm operators have off-farm employment, which is less than the 54% overall for

South Dakota (USDC, 1989, 7). This finding may suggest that sustainable farm families are more fully occupied with farm work than their conventional counterparts. Part of the off-farm employment difference arises, however, because the sustainable farmer survey was limited to fully commercial farmers.

The types of off-farm employment undertaken by the sustainable farmers are diverse, with only 2 people having the same job, carpentry. Other jobs by husbands are as follows: REA Board of Directors, County Commissioner, university professor, field disc sharpener, hog buyer, and private farm input business. Jobs by wives include relief postal worker, baby sitting and store clerk, receptionist, owner of a clothing store, teacher, and nurse.

SUSTAINABLE CROP ROTATIONS

A crop rotation is commonly viewed to represent the successive planting of different crops in the same field. It is described in terms of the patterned sequence of crops that repeats itself during each rotation cycle. The principal crop rotations followed by 20 of the 22 farms studied, however, do not lend themselves to such a simple characterization.[3] The actual rotations commonly vary from year to year and even from place to place on a particular farm within a given year for 3 basic reasons:

- Many of the sustainable farmers are actively experimenting with different types of rotations to determine the most effective utilization of their unique combinations of natural production resources;[4]

- Many of the sustainable farmers vary the crops in their rotations, from year to year, depending on current natural resource conditions (e.g., soil moisture, soil fertility, weeds and other pests), current conditions for participating in government farm programs, and prospective crop prices; and

- Some of the sustainable farmers do have something approaching "overall representative crop rotations," but in practice they follow different variations of the representative rotations at different times on different fields.

Thus, many of the sustainable crop rotations do not lend themselves to succinct and definitive characterization. Nevertheless, the results of our best efforts to describe the rotations are reported in Annexes 2 and 3. Annex 2 provides a narrative description of the various crops included in the respective rotations and a highlighting of the management practices followed with the rotations. Annex 3 provides a detailed enumeration of the cultural

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[3]Even for one of the other two farmers, the particular small grain included in his rotation varies from year to year.

[4]This experimenting is most often in regard to different cultural practices for "standard" small grains, row crops, and forages. In some cases, however, the experimenting is with respect to different varieties of "standard" crops and/or the introduction of "new" crops, e.g., lupine, mung beans, amaranth.

operations followed in each rotation. Readers are encouraged to study these annexes carefully.

Characterization of sustainable crop rotations

Of the 22 farmers, 10 are "totally crop organic" from the standpoint that they use no synthetic chemical fertilizers and pesticides on any of their cropland (Table 2).[5] Five farmers have "organic" crop rotations, but also have some cropland on which some synthetic chemicals are used. Seven farmers use reduced levels of synthetic chemicals on their crops, but are yet to completely eliminate the use of chemicals on any of their cropland. The incidence of synthetic chemical use on sustainable farms in the West and Northeast is less than that in the other regions.

At least one small grain is found in all the sustainable rotations. The most common small grain in the 22 rotations collectively is oats (in 68% of the rotations), followed by spring wheat (50%), rye (46%), and millet (32%). Oats and spring wheat are commonly used as nurse crops in the seeding of forage legumes (most commonly, alfalfa and sweet clover). Rye is becoming increasingly popular, partly for its perceived weed control features.

The most distinctive patterns of small grain crops, by individual region, are as follows:

- All 5 farms in the Northeast have either spring or winter wheat, and 4 have both rye and millet;

- The most common small grain in the East Central Region is oats (6 of 7 rotations), followed by spring wheat (3);

- The most common small grains in the South Central Region are oats and rye (4 of 7 rotations for each), followed by spring wheat (3);

- The most common small grains in the West are oats, millet, and winter wheat (2 of 3 rotations for each); and

- Two of the rotations in the East Central and Northeast regions have flax, 2 in the East Central Region have barley, and 1 in both the Northeast and West regions has buckwheat.

At least 1 row crop is found in 20 of the 22 rotations, including all rotations in the South Central, East Central, and Northeast regions. The most

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[5]Farmers were asked to report "typical" cultural practices on their farm, including their use or non-use of synthetic chemical fertilizers and pesticides. Those farmers in a transition stage in their use of chemicals gave us information on their 1988 and/or 1989 chemical use. When information for both these years was available, we based our classification on the 1988 data. Appropos to this, one farmer in the East Central Region has switched from very limited use of synthetic chemicals in 1988 to zero chemicals on his entire farm in 1989.

common row crop is soybeans (77% of all rotations), with soybeans being included in all 5 rotations in the Northeast and in 6 of the 7 rotations in both the South Central and East Central regions. Corn is second most common (66% of all rotations), with all 7 rotations in the East Central region, 5 of 7 in the South Central region, and 2 of 5 in the Northeast having corn. Two farmers include sunflowers in rotations in the Northeast and one includes grain sorghum in the South Central region.

Seventeen of the 22 rotations have alfalfa, with alfalfa in all 7 East Central, 6 of 7 South Central, 2 of 3 West, and 2 of 5 Northeast rotations. The only other harvested forage legume reported is red clover which is in one East Central rotation.

Eighteen of 20 legume forage seedings involve the use of small grain nurse crops. However, one farmer seeds alfalfa in the fall under the cover of fall-planted oats, and one interseeds alfalfa or sweet clover in corn either when corn is planted[6] or at last cultivation.

After the establishment year, 8 farmers harvest alfalfa for 4-5 years, 4 for 2-3 years, 2 for 1 year, and 2 for 6-7 years. The 2 farmers who leave alfalfa for only 1 year do so to minimize alfalfa's impact on soil moisture depletion and maximize alfalfa's impact on weed control. Also, because soybeans is less moisture-demanding than corn, these 2 farmers follow alfalfa with soybeans rather than with corn.

Summer fallowing represents situations in which no crop is harvested from fields during an entire calendar year. Twelve rotations involve at least 1 year of summer fallowing. With 7, a cover crop (most commonly sweet clover, but sometimes forage sudan) is used,[7] and with 5 black fallow is. Cover crop summer fallowing is spread across all 4 regions, whereas black fallowing is limited to the Northeast and West.

Three of the summer fallowings involve fallowing once in 3 years. One farmer reports fallowing once in each of 2, 5, and 7 years. Fallowing is more intensive (frequent) in the West than the Northeast, and far greater in these 2 regions than in the other 2 regions. Two farmers rest their land every 7th year, one in the South Central Region under cover of forage sudan and sweet clover, and one in the West under cover of matured weeds.

The most common summer fallow cover crop is sweet clover (7 of 9), followed by forage sudan (2 of 9). Three rotations (one in each of the South Central, East Central, and West regions) also involve the spring plowing down of sweet clover seeded the prior fall.

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[6]If the farmer interseeds alfalfa or sweet clover when his corn is planted, he hand weeds rather than mechanically cultivates the corn.

[7]The land summer fallowed with a cover crop is sometimes used as set-aside in farm program participation.

The following listing of regionally distinct characteristics represents a "first-cut" typological description of South Dakota's sustainable crop agriculture. Because this typology is based on so few observations and the underlying issues are so intertwined, one should view this first-cut typology as indicative only.[8]

South Central Region

- Cropland acreages somewhat smaller (average of 425 for the 7 studied farms in 1988) than in the East Central Region (535 average), considerably smaller than in the Northeast (760 average), and very much smaller than in the West (1,500 average).

- Rotations relatively balanced between small grains and row crops, with a definite presence of harvested forage legumes.

- Limited summer fallowing with cover crops (2 of 7 rotations), with 2 instances of sweet clover and 1 of forage sudan.

East Central Region

- Collectively, rotations less complex than elsewhere, e.g., 4 of 7 rotations have a common pattern of Soybeans - Corn - Small grain - Forage Legume and 2 others do not differ greatly from this pattern.

- Rotations relatively balanced between small grains and row crops, with a definite presence of harvested forage legumes.

- Row crops (soybeans and corn) slightly more prominent than in the South Central Region, and far more common than in the West.

- Harvested legume forages slightly more prominent than in the South Central Region, with all 7 farmers harvesting alfalfa and 1 harvesting red clover as well. Also, the length of time alfalfa is harvested, after being established, is shorter than in other regions.

- Limited summer fallowing with cover crops (2 rotations with sweet clover).

Northeast Region

- Intermediate cropland acreages (average of 760).

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[8]As further research results on farmers' sustainable agriculture practices in South Dakota become available, this typology will be updated and modified. A specific focal point of attention will be comparing the sustainable farms with typical farms in the State based on U.S. Census and other pertinent data.

- Small Grain - Summer Fallow a fundamental component of rotations; soybeans also present in all studied rotations and corn in 2 of 5 rotations.

- Extent and diversity of small grains greater than elsewhere, e.g., 80% of the farms have either spring or winter wheat and both rye and millet.

- Forage legumes less important here and in the West than in either other region.

West Region

- Large cropland acreages (average of 1,500).

- Small Grain - Summer Fallow a fundamental component of rotations.

- More intensive (frequent) fallowing than in other regions, e.g., 67% of rotations have black fallowing.

- A row crop (corn) found in only one rotation, covering less than one-tenth of the farmer's total cropland.

Cultural operations

Cultural operations undertaken by farmers for each crop, including summer fallowing, in the respective rotations are indicated in Annex 3. Six categories are included: (1) pre-plant land preparation; (2) fertilizer, manure, and pesticide application; (3) planting; (4) weed control; (5) harvest; and (6) post-harvest.

Except for fall-seeded winter wheat and rye, the cultural operations shown for each crop are those performed for the crop during the calendar year. Thus, pre-plant land preparation operations for spring-seeded crops are performed in the spring and post-harvest operations are performed in the fall. For fall-seeded winter wheat and rye, however, the fall-performed pre-plant tillage and planting operations are shown in the tables as if they were performed in the spring.

Data on selected cultural operations for major crops are summarized in Table 3. The average numbers of cultural operations per year for corn and soybeans are 9.2 and 8.9, respectively. For small grains, the average numbers range from 7.9 for oats to 5.9 for winter wheat. The numbers of cultural operations for specific crops vary widely among farmers, however. The widest relative range among farmers is 3 to 13 for oats and the narrowest is 6 to 11 for soybeans.

The average number of **field tillage operations** for row crops is 2.7-2.8 per year per crop. For small grains, the range is 2.1 (spring wheat) to 2.9 (winter wheat). Somewhat over one-half of the farmers with spring wheat (64%) and corn (56%) perform fall tillage operations after crop harvest. The corresponding percentages for oats and soybeans are 50% and 44%, respectively. The only discernible difference among regions in cultural practices is an

above-average relative incidence of fall tillage following soybeans in the East Central Region.[9]

The average number of **weed control operations** with corn and soybeans is 3.9 per crop per year. Fifteen of the 16 farmers with both crops cultivate for weed control. From 2 to 3 cultivations per season are most common for corn; 2 cultivations are for soybeans. The second most important type of mechanical cultivation in corn and soybeans is the rotary hoe, with it being used in about one-half of the rotations. One rotary hoeing is most common, although in some instances 2 passes are used. Dragging or harrowing is used in 38% and 44% of the soybean and corn rotations, respectively. Hand weeding is reported with 63% and 25% of the respective soybean and corn rotations. Of equal or less relative incidence is the use of herbicides (19% and 25% of the soybean and corn rotations, respectively).

For the spring-planted small grains--oats and spring wheat--averages of only 0.6 to 0.8 weed control operations are performed per year per crop. Dragging or harrowing is most common (43% and 36% of the rotations). Herbicides are used with 29% and 27% of the oat and spring wheat rotations, respectively. In about 30% and 45% of the oat and spring wheat rotations, respectively, no post-planting weed control operations are performed. Weed control with the fall-planted small grains--winter wheat and rye--is limited to dragging and harrowing, and even then with smaller proportions of the rotations than with the spring-seeded small grains.

The **moldboard plow** is used by 80% of the Northeast farmers, 57% in the East Central Region, 29% in the South Central Region, and none in the West. All 10 farmers using the moldboard plow do so to incorporate alfalfa or sweet clover. Two also use the moldboard plow following small grain, and one following the application of an organic soil conditioner on soybean ground.

The **tillage** operations during the **black summer fallowing** periods in the 5 rotations under study are rather diverse, as follows:

- 7 chisel plowings, with sweeps;
- 6-7 field cultivations;
- 4-5 field cultivations, with sweeps;
- 3 tandem discings; and

[9]One must remember, however, that the number of observations on which this and other findings are based is relatively small (Table 3, row 1).

- 1-2 field cultivations, with sweeps, in combination with 1 tandem discing and 1 rotary mowing of weeds.[10]

With 13 rotations, **manure is spread** on at least one rotation component. Of the 19 reported instances of spreading manure (manure is spread on two components of 6 rotations), 47% involve manure being applied following small grain harvest, 26% following row crop harvest, 16% after fallow or legume forage plow-down, and 11% on alfalfa.

[10]To conserve added moisture during summer fallowing, this farmer is experimenting in 1989 with summer fallowing in which rather frequent short-cut rotary mowings replace tillage for weed control.

LIVESTOCK ENTERPRISES

Nature of enterprises

Eighteen of the 21 farmers responding to Part I of the questionnaire indicate that they have commercial (arbitrarily defined to involve 5 or more head) livestock enterprises.[11] Thirteen farmers have beef cow-calf operations and 9 finish cattle. Four farmers have hog farrowing operations, three hog finishing operations, and one in the South Central region a dairy herd.

Eight farms specialize in only one livestock enterprise, as follows: 6 - beef cow-calf, 1 - cattle finishing, and 1 - hog finishing. The other 10 farms have diversified livestock operations as follows: 4 - beef cow-calf and cattle finishing; 2 - beef cow-calf and hog farrowing; 2 - cattle finishing, hog farrowing, and hog finishing; 1 - beef cow-calf, cattle finishing, hog farrowing, and hog finishing; and 1 - cattle finishing and dairy.

Differences among regions in the nature of livestock enterprises are as follows:

- All 3 farms in the West have beef cow-calf operations, whereas only between 40% and 60% of the farms in the other 3 regions do;

- The highest relative incidence of cattle finishing is in the Northeast (3 of 5 sustainable farms); in strongest contrast, no cattle finishing (not unexpectedly) takes place on the farms in the West; and

- Farms with hog farrowing and hog finishing operations are limited to the South Central and East Central regions.

The 13 sustainable cow-calf enterprises involve herd sizes of 5 to 150 cows and an average of 45 cows per herd (Table 5). The most common herd size category is 25-49 cows, followed by 5-25 cows. These herds are considerably smaller than average in South Dakota, with only 2 being larger than the State average of 79 cows per farm (USDC, 1989, 27). Herd sizes on sustainable farms do not appear to differ among regions.

Of those that finish cattle, 4 raise all the feeders they place on feed, 1 raises 42 of his 45 feeders, and 3 buy all their feeders. One of the 8 buys and feeds only Holstein steers. The mean sustainable cattle finishing enterprise of 26 head is far smaller than the State average of 150 head per feeder (USDC, 1989, 28).

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[11]The questionnaire called for information on typical livestock enterprises on the sustainable farms over the period 1984-1988. As with crop rotations, however, these data are not yet stabilized on some farms. Thus, some farmers provided information for only 1988 and/or 1989. If information was provided for both 1988 and 1989, we used their 1988 livestock data.

Four of the 5 farmers who farrow hogs have between 8 and 12 sows. The fifth farmer farrows about 45 sows. On the average, these hog farrowing operations are smaller than the State average of 31 sows per farm (USDC, 1989, 31). Each of the 5 sustainable hog breeding enterprises involves sows farrowing twice per year. The 4 smaller farrowing operations involve sows farrowing at 2 different times a year, and the larger operation 4 times a year.

The 3 hog finishing operations involve 180, 250, and 700 hogs per year. Each producer raises all his feeder pigs. In general, the scale of these hog finishing operations is in line with the State average of 315 head per operator (USDC, 1989, 31).

Sustainable management practices

Of the 18 sustainable farmers with livestock operations, 14 consider themselves to raise their livestock sustainably, 2 follow a combination of sustainable and conventional practices, and 2 do not follow sustainable practices. Descriptions of the farmers' management practices are presented in Annex 4. A two-part summary statement is provided here: practices consistent with the majority of practicing farmers and practices unique to 1 or 2 of the farmers.

Common sustainable livestock management practices. Two types of management practices are reported as "sustainable" by a majority of the 16 practicing sustainable livestock farmers:[12]

- The feeding of only organically grown grain and roughage to livestock; and

- The non-use of (1) antibiotics and other additives in concentrate feeds, (2) hormones and other growth stimulants/promotants, (3) insecticides, (4) vaccinations of animals, and (5) closed confinement facilities.[13]

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[12]In reporting these practices, the research team is not implying that any or all of the practices are necessarily associated with the reduced presence of chemical residues in livestock meat.

[13]Some farmers report "not using drugs or shots" with their livestock. It is not fully clear, however, whether they refrain from treating infected animals with occasional antibiotics and/or believe that refraining from doing so is essential to raising livestock "sustainably."

Unique sustainable livestock management practices. The following practices were reported by only 1 or 2 farmers each:

- Finishing cattle with a higher proportion of roughage to grain;[14]

- Substituting hay for silage in cattle finishing;

- Substituting silage for grain in dairy production;

- Feeding probiotics to dairy cows;

- Allowing weaned calves to again run with their mothers both before and after subsequent calving;[15] and

- Preventing over-grazing.[16]

Feeds used

Nine farmers with sustainable beef cow herds report their most common roughage to be grazing pasture (Table 6). Eight rely on grazing for more than 40% of their roughage needs, and 3 for more than 60% of their roughage needs. All 9 farmers also feed hay, but only 1 of them relies on hay to meet more than 60% of his roughage needs. Only 1 farmer feeds silage, and that meets only 10% of his total roughage needs.

Three of the 6 sustainable cattle finishers feed a combination of hay and grain, with the following hay-grain percentage combinations: 50-50%, 55-45%, and 80-20%, respectively. The other three feed the following diets: (1) 50% - grazing, 25% - hay, and 25% - dry grain; (2) 50% - silage (haylage), 40% - dry grain, and 10% - hay; and (3) 90% - silage (haylage) and 10% - dry grain. The role of grain in these finishing diets is considerably less than the average of 75% to 80% for cattle feeders generally in the State (Taylor, Wagner, and Kappes, 1989).

The two sustainable hog farrowing farmers feed grain-protein supplement combinations of 80-20% and 88-12%, respectively. For finishing hogs, the

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[14]As noted later, the actual practice of all sustainable farmers who finish cattle is to feed atypically high proportions of roughage to grain. One farmer reports that he believes this practice leads to less disease problems.

[15]This farmer believes that his young cattle thereby have quieter dispositions and gain faster.

[16]This farmer believes that the prevention of over-grazing keeps his livestock from picking up soil-borne diseases and particles.

grain-protein supplement combinations are 83-17% and 84-16%, respectively.[17] The sustainable dairy farmer feeds 60% - silage (haylage), 20% - high moisture grain, 10% -hay, 7% - grazing, and 3% - protein supplement.

Of the 14 sustainable livestock farmers, only 2 (both beef cow-calf operators) feed purchased grain and/or roughage. One farmer in the West Region buys all the corn that he feeds to his 24 "backgrounded" feeder cattle and one farmer in the East Central Region buys 5% of the hay for his 14 beef cows.

Manure management

All 18 farmers with livestock report using all the manure they produce on their farms. While no one reports buying manure from others, 2 farmers obtain manure from others with no payment for the manure. One does so from a neighbor--to meet 30% of the total manure he applies. The other farmer secures 20% of his farm's total manure applications through an arrangement in which his neighbor, in exchange, raises hogs in facilities on his farm.

The proportions of various farmers' cropland that receive manure applications are low. For example, 6 farmers cover 5% or less of their cropland once with manure--over the period of their respective crop rotations (Table 7).[18] Three apply manure once to between 6% and 20% of their cropland. The crop rotations on these 9 farms range in length from 5 to 10 years. The 3 farmers who make the heaviest manure applications cover the following percentages of their cropland once each 3 years: 30%, 50%, and 60-75%.

If an additional supply of manure were available, 5 farmers indicate they would probably be interested to buy it. Two indicate they might be interested, but first they would need to check the weed status of the manure and the price being asked. One indicates he would take it if the manure were "free." The other 10 say they would not be interested in buying manure from others, with the most important reason being concern over possible weed seed in the manure, followed by their already having too much work to do.

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[17]One of the hog farmers feeds his sows and finishing hogs a limited quantity of straw (about 2% of their total diets).

[18]Of these 6, 1 applies most of his limited manure to his garden, 1 applies his manure only to his pasture (because of pigweed problems on his cropland), 1 limits the application of his limited manure supply to hilltops to try to replace topsoil, and 1 applies his limited manure to cropland areas lowest in organic matter.

RISK EVALUATION[19]

Relative risks with sustainable versus conventional farming practices

The 21 farmers responding to Part I of the questionnaire were asked to indicate whether in their judgment sustainable agriculture involves more or less risk than conventional agriculture. Eleven perceive less risk, 3 more risk, 2 both more and less risk, and 5 no difference in risks.

In explaining their responses, farmers drew attention to 4 types of risk: financial, production, market (price), and health/environment.[20] Each is discussed in turn, with consideration (as applicable) first to ways in which sustainable agriculture is less risky and second more risky.

Financial risk. Eleven farmers indicate that financial risks are less with sustainable agriculture. Their main argument derives from reduced off-farm input purchases. With sustainable practices, the need to use--and thereby incur a later obligation to pay back--borrowed operating capital is less. Two farmers also believe that risks are less if one is not obligated to seek and pay attention to the advice of external agricultural input suppliers and bankers.

On the other hand, two farmers find added financial risks with sustainable agriculture. For one, this situation arises because of greater difficulty in his being able to secure even the limited amount of credit needed to meet his production expenses. He has found a definite reluctance of financial institutions to grant credit for purchases involving sustainable farming practices.

Another farmer cites increased short-term financial (liquidity) risks because of uncertainties about when he will be able to sell and actually receive payment for his organic produce. Payments can be delayed as much as 2 years after the time of crop harvest.

Production risk. Eight farmers cite impacts of sustainable agriculture on production risks. The most common source of reduced production risks revolves around farmers having "their eggs in more than one basket" through enterprise diversification. Since sustainable farmers generally have a larger number of enterprises than their conventional counterparts, the chances are greater that--when conditions are unfavorable for some of their farm enterprises--at least somewhat counterbalancing forces will be operating with respect to others of their enterprises.

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[19]A current Graduate Assistant in the Economics Department, Liong Min Tiong, is responsible for some of the underlying tabulations in this section. Her thesis will cover in considerably more detail than here the topic of risks in sustainable agriculture.

[20]These categories of risk were <u>not</u> pre-specified in the questionnaire.

A special variation of the enterprise diversification theme is that, in years of grain crop failure, livestock which are common on sustainable farms can often make constructive use of lower-valued, failed crops. Thus, returns to the cropland can be enhanced through livestock relative to a non-livestock farmer either (1) having to incur harvesting costs that are large in relation to a small crop or (2) realizing no return at all from an unharvested crop.

Several farmers draw attention to sustainable farmers being less vulnerable to year-to-year fluctuations in rainfall than their conventional counterparts.[21] Production risks during years of limited rainfall are less because of the enhanced soil water holding capacity associated with improved soil structure and organic matter content resulting from sustainable farming practices. Production risks during years of excessive rainfall can be less because sustainable practices contribute to reduced soil erosion.

Two farmers mention a positive association between farmers deciding to undertake sustainable practices and their exercising sound management practices. One believes that when people elect to farm sustainably they thereby derive direct, positive incentive to improve their management. Part of becoming an improved farm manager is learning to cope better with risks. Another says that, when people take up sustainable farming practices, they know the managerial requirements will be greater. As they respond to the greater managerial requirements, they both (1) become more familiar with and make better use of the unique natural resources on their farms and (2) become overall more seasoned, stronger farm managers.

From certain standpoints, however, production risks can be greater with sustainable agriculture, particularly during the transition from conventional to sustainable practices. Such expanded risks arise with the change from known conventional to unknown sustainable technologies, the same as with any other technological change. This point, emphasized by several farmers, is captured by the farmer who says, "it may take a few years to find out what does and does not work." Another farmer presents a meaningful analogy with drugs:

> "Any major change in your operation is risky. Of course, the risk is greater while you are making the switch. The land is like a drug addict, always wanting its 'fix' of synthetic chemical fertilizers and pesticides. The first 5-6 years you take the land off its addiction, the land will be slowly healing itself. The transition period can be a time of economic hardship and self-doubt. As time passes, however, you eventually realize that sustainable agriculture was really the only choice you had."

Because of unknowns in switching to sustainable agriculture, one farmer recommends managing risks by converting to sustainable practices only 20-30% of one's land at any one time.

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[21]One farmer also mentions a lesser vulnerability of sustainable farmers to year-to-year variations in insects.

From a more technical production standpoint, expanded weed and other pest pressures during the transition can make a crop especially vulnerable to yield impairment. Possible short-term nitrogen shortages that also frequently arise during the transition can lead to a similar end. No matter whether during or after the transition, some farmers believe the risks of untimely cultural operations to be particularly critical with sustainable agriculture.

Market (price) risks. Four farmers draw attention to changed market (price) risks with sustainable agriculture. Output price risks with sustainable agriculture can be less because of the argument noted above concerning "eggs being in more than one basket" as a result of greater enterprise diversification on sustainable farms. Risks of unexpected price changes for off-farm inputs are less because of fewer input purchases by sustainable farmers.

Two farmers believe price premium bonuses for organic products result in reduced market risks for sustainable producers. Because organic product markets tend to be very thin, however, prices of organic products are likely to be **less stable** than are those for conventionally produced farm products. Further, the absence of Federal farm programs for legume forages and most livestock products integral to many sustainable farm operations removes informal "government guarantees" of prices for those commodities that can be enjoyed by grain farmers who participate in Federal farm programs.

Health and environment risks. Four farmers cite an impact of sustainable agriculture on health and environmental risks. Three emphasize the reduced risk to the health of farm workers because they no longer have to handle potentially dangerous chemicals. One also cites reduced risks from sustainable practices to groundwater contamination and wildlife habitat impairment. Further, the risks of health impairment to diet-sensitive food consumers can be less when such people eat sustainably produced farm products.

On the other hand, one sustainable farmer cites increased physical, mental, and emotional health risks that can arise as a result of personal ridicule to sustainable farmers from members of the local community and from possible actions by "threatened" conventional farmers.

Comparative sustainable and conventional yields under contrasting production conditions

Farmers were asked to provide comparative estimates of sustainable and conventional yields for each crop during each of unusually favorable ("best"), "most normal," and unusually unfavorable ("worst") production conditions during the period 1984-1989. As an intended aid in answering this question, respondents were asked to first cite which year most fully illustrated each production condition.

Responses for illustrative best and normal years are widely divergent among farmers, with no one year being mentioned for either condition by a majority of farmers (Table 8). For example, 7 farmers selected 1987 as the best production year, but 9 selected a different year. Three years--1984,

1985, and 1986--were each cited by 4 farmers as being normal. A fairly strong consensus exists, however, on 1988 being worst for production.

The divergence of judgments among farmers on production conditions in particular years reflects (1) real differences in **general** production conditions from place to place, (2) real differences in **some particularly critical** production conditions from place to place,[22] and/or (3) an inability for farmers to recall clearly prior production conditions.

The sustainable farmers' judgments on sustainable versus conventional yields are summarized in Tables 9-11. They are discussed here by crop.

Corn. In normal production years, 3 farmers indicate sustainable yields to be higher than conventional yields, 1 the yields the same, and 7 the yields less.

During the year with the best growing conditions, sustainable yields are reported to lose some ground relative to conventional yields, with 3 farmers indicating yields to be the same and 6 yields less. During the year with the worst growing conditions, on the other hand, 4 farmers report similar yields, 1 yields to be higher with sustainable practices, and only 2 less. This pattern of (1) a relative loss in sustainable versus conventional yields during years of **unusually favorable** production conditions and (2) a relative gain in sustainable versus conventional yields during years of **unusually unfavorable** production conditions is consistent with that reported by Klepper, et al. (1977) and Lockeretz, et al. (1980) for corn producers in the Corn Belt.

While the numbers of observations for individual regions is very limited, the general patterns of relative yield differences in sustainable versus conventional yields among best, normal, and worst crop growing conditions are the same in each of the South Central and East Central regions as those just described for the State. The one farmer with pertinent data in the Northeast reports no difference between sustainable and conventional corn yields under any of the 3 production conditions.

Soybeans. In normal production years, 1 farmer indicates sustainable yields to be higher than conventional yields, 4 the yields to be the same, and 5 the yields less.

During the year with the best growing conditions, sustainable soybean yields are reported to lose some ground relative to conventional yields, but to a lesser extent than that reported for corn. During the year with the worst growing conditions, however, sustainable soybean yields definitely gain relative to conventional yields--with 7 farmers reporting comparable soybean yields and only 1 lower yields with sustainable practices.

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[22]The variable production condition mentioned most often by farmers is precipitation, both total amount and timing. Other variable production conditions cited by farmers are sub-soil moisture, temperatures, winds, hail, and weed and other pest pressures.

The region most closely mirroring this pattern for the State is the Northeast. The South Central Region, on the other hand, fails to reflect a pattern of a relative loss in sustainable versus conventional yields during years of unusually favorable production conditions and a relative gain in sustainable versus conventional yields during years of unusually unfavorable production conditions.

Oats. In normal production years, 1 farmer indicates sustainable yields to be higher than conventional yields, 4 the yields the same, and 4 the yields less. During the year with the best growing conditions for oats, the relative pattern of sustainable versus conventional yields differs little from that for normal production conditions.

During the year with the worst growing conditions, however, sustainable oat yields definitely improve relative to conventional oat yields. For example, during the worst year, only 1 farmer reports sustainable yields to be less than conventional yields, compared to 4 farmers during a normal production year.

Spring wheat. In normal production years, 3 farmers report sustainable yields to be the same as conventional yields and 4 the yields to be less. The same general patterns of relative sustainable versus conventional yields for oats during best and worst production years are reflected with spring wheat.

Alfalfa. All 9 farmers responding to the comparative yield question for alfalfa report similar sustainable and conventional yields in normal production years. During the year with the best growing conditions, 2 farmers report sustainable yields to be higher and one lower. During the year of worst production conditions, no differences between sustainable and conventional yields are reported. Thus, alfalfa does not show the same pattern of relative changes in sustainable versus conventional yields under unusual production conditions as that shown for the row crops and small grains. This finding is not surprising in view of the generally limited usage by most conventional farmers of synthetic fertilizers and pesticides on alfalfa.

In comparing the data in Tables 9-11, a pattern of intercrop differences emerges. In general, yield differences between crops grown under sustainable versus conventional farming practices are believed to be greatest for the row crops (corn and soybeans), intermediate for the small grains (oats and spring wheat), and least for alfalfa.

This pattern for row crops and small grains appears to be generally consistent with that reported by Shearer, et al. (1981) on Midwestern beef and hog farms. However, the pattern is only partially reflected in results reported by Lockeretz, et al. (1978 and 1981) for Midwestern farmers. The point of greatest contrast is a much greater relative disadvantage of sustainable versus conventional yields for wheat than for either corn or soybeans in the Lockeretz, et al. studies.

Risk protection

Sixteen farmers currently purchase some type of crop insurance (Table 12). All surveyed farmers in the Northeast and West do, but only 57% of those in the other regions do. Of those purchasing insurance, 94% buy Federal multiple peril crop insurance and 25% private hail insurance. Of farmers who raise the respective crops, the following percentages purchase insurance: 100% barley (only 2 farmers), 67% - wheat, 60% corn, 53% - oats, 50% - sunflowers (only 2 farmers), 47% - soybeans, and 10% - rye.

Of those farmers purchasing Federal multiple peril crop insurance, 69% elect the 65%-of-normal-yield coverage level. This coverage level is most popular in the West and least popular in the East Central Region. Two farmers elect the 50% option and one farmer the 75% option. The most popular level of price coverage is "medium," followed by "low" and "high," respectively.

The average period that the currently insured have bought Federal crop insurance is 5 years, but this period varies much (from 1 to 28 years) among farmers. The average period of carrying insurance is greatest in the East Central Region (9 years), followed by the South Central Region (5 years), the West (3 years), and the Northeast (2 years). Slightly less than one-half of the farmers buying Federal crop insurance in 1989 said they did so because of the 1988 Federal drought relief program requirements.

Three-fourths of those currently purchasing crop insurance have at least at one time tried to collect crop insurance on crop losses occurring on sustainably farmed land. None of them has experienced trouble collecting insurance payments because of their land having been farmed sustainably.

MANAGERIAL STRATEGIES FOR MEETING SELECTED CHALLENGES OF SUSTAINABLE AGRICULTURE

Transition weed problems

The most critical problem in converting from conventional to sustainable farming practices reported by farmers in the Summer 1988 mail survey was exaggerated weed pressure. Thus, in the personal interviews, farmers were asked for their advice if they were counseling a farmer considering to shift from conventional to sustainable farming how best to cope with likely increased weed problems.

The individual farmer responses for controlling weeds during the transition period are reported in Annex 5. Strategic elements included in a majority of responses are noted first, followed by strategies mentioned by only a few farmers.[23]

The vast majority of farmers emphasize the importance of crop rotations in controlling weeds. The principal role of crop rotations in weed control is to interrupt the growth cycles of individual weed species. This control is achieved through the use of forage crops alternating with row and small grain crops. The presence of forage legumes is noted by farmers to be particularly effective in combatting weeds due in large part to the competitive nature of these crops.[24]

Some farmers draw attention to the allelopathic (a suppressing of growth of one plant species by another, e.g., by the exuding of chemicals from roots toxic to weeds), heavy tillering (root space competition), and wide leaf canopy (shadowing) features of crops such as rye, millet, and buckwheat in helping to effectively combat weeds. One farmer also indicates that the inclusion of non-row crops in rotations frees up time from the overall farm to do a better job of combatting weeds in those row crops that he does have.

The second most common strategy for controlling weeds is mechanical cultivation. Emphasis is placed on both the nature and timing of mechanical weed control. Several farmers mention the use of the moldboard plow (in particular circumstances only), chisel plow, noble blade, rotary hoe, offset and tandem discs, and rotary mower. Deep tillage is quite often mentioned as important to gaining control over weeds.

Several farmers emphasize the importance of the delayed planting of row crops in the spring to allow the prior tilling-in of weeds. One farmer suggests planting early crops (e.g., oats, wheat) one year and later crops (e.g., soybeans, sunflowers) the next year. Mechanical cultivation of row

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[23]In this discussion, attention is sometimes drawn to pertinent responses by farmers to questions other than those reported in Annex 5.

[24]Most farmers mention alfalfa in this regard. One farmer, however, draws attention to the role of sweet clover in mellowing the ground and eliminating pigeon grass.

crops needs to be correctly timed relative to weed and main crop plant growth. Several farmers indicate that tilling ground after small grain harvest helps them to achieve effective weed control.

Other practices suggested by farmers for controlling weeds include the following:

- Composting manure to destroy weed seed;
- Increasing plant populations to provide wider canopy to shade out weeds;
- Clipping weeds before they go to seed in summer fallowed fields;
- Burning thistle patches with a torch; and
- Overcoming mineral deficiencies in the soil.[25]

Transition nitrogen shortages

Another problem in converting from conventional to sustainable farming practices commonly mentioned in the literature is nitrogen shortage. Nitrogen shortages can be acute during the transition period if a gap exists between (1) when external nitrogen supplies are withdrawn and (2) when natural nitrogen-producing processes become fully operational. Thus, the judgments of farmers for dealing with transition nitrogen shortages were also sought through the personal interviews. Their responses are indicated in Annex 6.

Crop rotations dominate even more the responses for dealing with nitrogen shortages than for dealing with weed problems. The specific feature of rotations most critical to meeting possible nitrogen shortages, of course, is the presence of legumes in the rotations. The legumes may be in the form of harvested or plowed-down forages (e.g., alfalfa, sweet clover) and row crops such as soybeans. Legumes are conducive to meeting nitrogen shortages, of course, because they fix atmospheric nitrogen. The plowing down of legumes contributes to the building up of soil organic matter and general soil tilth, both of which contribute to enhanced soil productivity and erosion control.

The second most common strategy for coping with possible nitrogen shortages is using livestock manure. Some apply the manure to fields "as-is," others compost the manure before applying it to fields, and 2 process and apply manure in liquid form.

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[25]One farmer suggests viewing weeds as "prairie plants," and learning to live with the presence of some of them. The only quite important means of weed control indicated by farmers in the mail survey that was not mentioned in the personal interview survey involves the use of only certified and/or "clean" seed (Taylor, Dobbs, and Smolik, 1989, 52).

Other strategies used by farmers for dealing with possible nitrogen shortages include:

- Turning back crop residues to the soil;

- Selecting crops that require less nitrogen;

- Setting "realistic" (presumably more modest) yield goals;

- Not leaving the ground bare during fallowing;

- Working the ground during fallowing to increase soil nitrogen; and

- Using modest amounts of chemical fertilizer, different forms of non-chemical fertilizer, or certain biodynamic preparations.

Finding markets for sustainably raised products

One of the 2 most important continuing problems with sustainable agriculture identified in the Summer 1988 mail survey is difficulty in finding markets for sustainably-raised products. The interviewed farmers were, therefore, asked to identify what they view as the 2 most important shortcomings in organic product marketing and for each to suggest possible solutions. The farmers' individual responses are reported in Annex 7.

The most common problem in marketing organic products arises from wholesale buyers not purchasing and taking possession of organic produce from farmers until the buyers have found markets for the produce. As a result, producers have to bear the burdens of (1) providing and meeting associated costs of on-farm storage for their organic produce and (2) an uncertain and uneven cash-flow over time. Two suggestions for resolving this problem are:

- Producers forward contracting with wholesale buyers for the production of certain quantities of organic produce; and

- Wholesale buyers either reimbursing farmers for storage (including interest) costs or purchasing and storing organic produce as soon as crops are harvested.

A second rather common problem with marketing organic produce concerns the distance from producers to plants where the organic produce is cleaned and assembled for shipping. Farmers suggest the development of additional terminals where organic produce can be cleaned and assembled.

A variety of other marketing needs are cited by various farmers: (1) a system for more formally accrediting wholesale buyers, so farmers and others can have greater confidence in the integrity of buyers; (2) a more precise definition of "organic" and clear labeling of officially certified organic products in South Dakota; (3) expanded market outlets for certain types of organic produce (e.g., corn, beef); and (4) an elimination of perceived "price gouging" in the processing and distribution of organic products.

Some farmers argue that organic price premiums should be greater than at present to compensate for the extra effort required in marketing organic produce, while others argue that organic produce should be sold at about the same price as conventionally produced products. Two arguments underlying the latter viewpoint are that the quantity demanded of organic produce will expand at lower prices and that organic produce is "lower cost" to produce.

Several farmers emphasize the need to provide education to the general public on (1) the health and nutritional advantages of organic produce and (2) the value of sustainable agriculture in promoting soil life, retarding erosion, reducing soil compaction, and preserving water quality. Several stress the value of sustainable agriculture organizations in identifying organic market outlets and in generally promoting sustainable agriculture interests.

Improving the development and dissemination of quality information on sustainable agriculture

The other most important continuing problem with sustainable agriculture identified in the Summer 1988 mail survey is a lack of up-to-date and accurate information on sustainable agriculture. As a result, this topic was also targeted for special emphasis in the personal interview survey.

One facet of exploration was determining farmers' current sources of information on sustainable agriculture (Table 13). The sources are quite diverse, with the most important being other sustainable farmers (20% of the responses). Own family experience and sustainable farming books and magazines each account for 16-17% of informational sources. At the other extreme, universities and purchasers of organic products each account for only 6% of informational sources; the Soil Conservation Service was cited by no one.

The farmers were also asked to suggest possible sustainable agriculture issues meriting attention in research. Their individual responses are indicated in Annex 8.

The only research topic suggested in common by several farmers is the comparative testing in formal research of sustainable and conventional crop rotations. Suggested focal points for emphasis in such work are soil fertility (e.g., nitrogen, phosphorous, organic matter, trace minerals), soil structure, soil microbial activity, and weed control. One farmer suggests a specific emphasis in research on the transition from conventional to sustainable practices. Most farmers implicitly suggest the research to be undertaken in formally controlled experiment station field plots.[26] One

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[26]Since 1985, SDSU has undertaken research at its Northeast Agricultural Experiment Station Research Farm on sustainable versus conventional and reduced tillage crop rotations. The most recent report covering the yield and economic results from the first 4 years of field trials is Mends, Dobbs, and Smolik (1989). Efforts by the U.S. Department of Agriculture and SDSU are currently underway to expand such comparative field trial testing of sustainable and conventional farming systems to

farmer, however, suggests the possibility of conducting such research on his and a neighboring conventional farm.[27]

Illustrative other areas suggested for research include: (1) the results of soil compaction on root growth, (2) breeding plants for disease resistance, (3) non-toxic methods of controlling weeds and other pests, (4) soil building crops to produce nitrogen and control erosion (e.g., vetch, clover, winter peas), (5) legumes for interseeding with cereal and row crops, (6) interrelationships between sustainable farming and groundwater contamination, (7) the impact on the presence of chemical residues in beef from sustainable versus conventional feeding and other cattle management practices, (8) comparative machinery and other capital investments on sustainable versus conventional farms, and (9) the purchase of organic inputs and the marketing of organic products.

The farmers were also asked for their suggestions on how sustainable farmers, private organizations involved with sustainable agriculture, and university extension and research personnel could communicate and otherwise work more effectively with each other. The responses to this question are reported in Annex 9.

The most common thread in the responses is the suggestion that "everyone" should remain open-minded about agriculture and not automatically assume that any one way is necessarily better or worse than another. Several farmers cite a perceived closed-mindedness, historically, by universities (extension, research, and teaching) to sustainable agriculture and a hope that this situation may turn around. SDSU's undertaking these surveys of sustainable farmers and other recent research on sustainable agriculture is viewed as possible beginning evidence for a turn-around. Farmers welcome involvement of the university with studies of different aspects of sustainable agriculture to determine what will work and what will not. Workshops involving co-sponsorship among various groups with interest in sustainable agriculture and universities are advocated by some farmers.[28]

One farmer sees an unmet need that represents an opportunity for the Extension Service to become involved in sustainable agriculture. He notes that, in general, there aren't private businesses to support sustainable agriculture to parallel the private businesses which develop and provide information to conventional farmers. Thus, public involvement in developing and disseminating information on sustainable agriculture if particularly needed.

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another site in South Dakota.

[27]Since 1984, SDSU has been undertaking a comparative study of a pair of neighboring sustainable and conventional farms in East Central S.D.

[28]Two sustainable agriculture workshops--involving both researchers and farmers as resource persons--are being planned in South Dakota for sometime during February 1990.

Farmers better or worse off from following sustainable practices?

Three of the 4 most important reasons indicated collectively by respondents for following sustainable practices in the Summer 1988 mail survey involved respondents being concerned about the implications of their farming practices for other people. This prompted us to raise the following 2 questions in the personal interview survey:

- Are you a sustainable farmer in spite of short-term adverse repercussions to you and your family, or

- Do you believe you and your family are better off in the short-term than if you farmed conventionally?

The responses to this question are reported in Annex 10. Considering the answers to each question, one-at-a-time, we learned the following:

1. Of the 12 farmers answering the first question, 8 replied yes and 4 no. This response reflects a majority of responding farmers to indicate that they farm sustainably in spite of short-term adverse repercussions to them and their families.

2. Of the 21 farmers answering the second question, 18 replied yes, 2 no, and 1 both yes and no. This response, in contrast with the response to the first question, reflects a strong affirmation of the positive impact of sustainable agriculture on the short-term welfare of sustainable farm families.

In seeking to reconcile this apparent contradiction, we discovered that our initial hypothesis--that farmers would respond yes to one question and no to the other--failed in 6 of 12 instances. In particular, 4 farmers answered no to the first question and yes to the second, 3 answered yes to the first question and no to the second, and 6 answered yes to both.[29] The rationale for 3 farmers answering yes to both questions is that "life" involves more than just economics. For one farmer, adverse repercussions come from the heavier work required with sustainable practices; but he and his family do not experience special personal stress from the hard work and economically, in both the short- and long-term, they are better off with sustainable practices.[30]

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[29]One farmer who answered yes to the first question answered both yes and no to the second question.

[30]The other 2 farmers do not indicate the basis for their responding yes to both questions.

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Figure 1. South Dakota map, regional location of the 22 personally interviewed sustainable farmers.

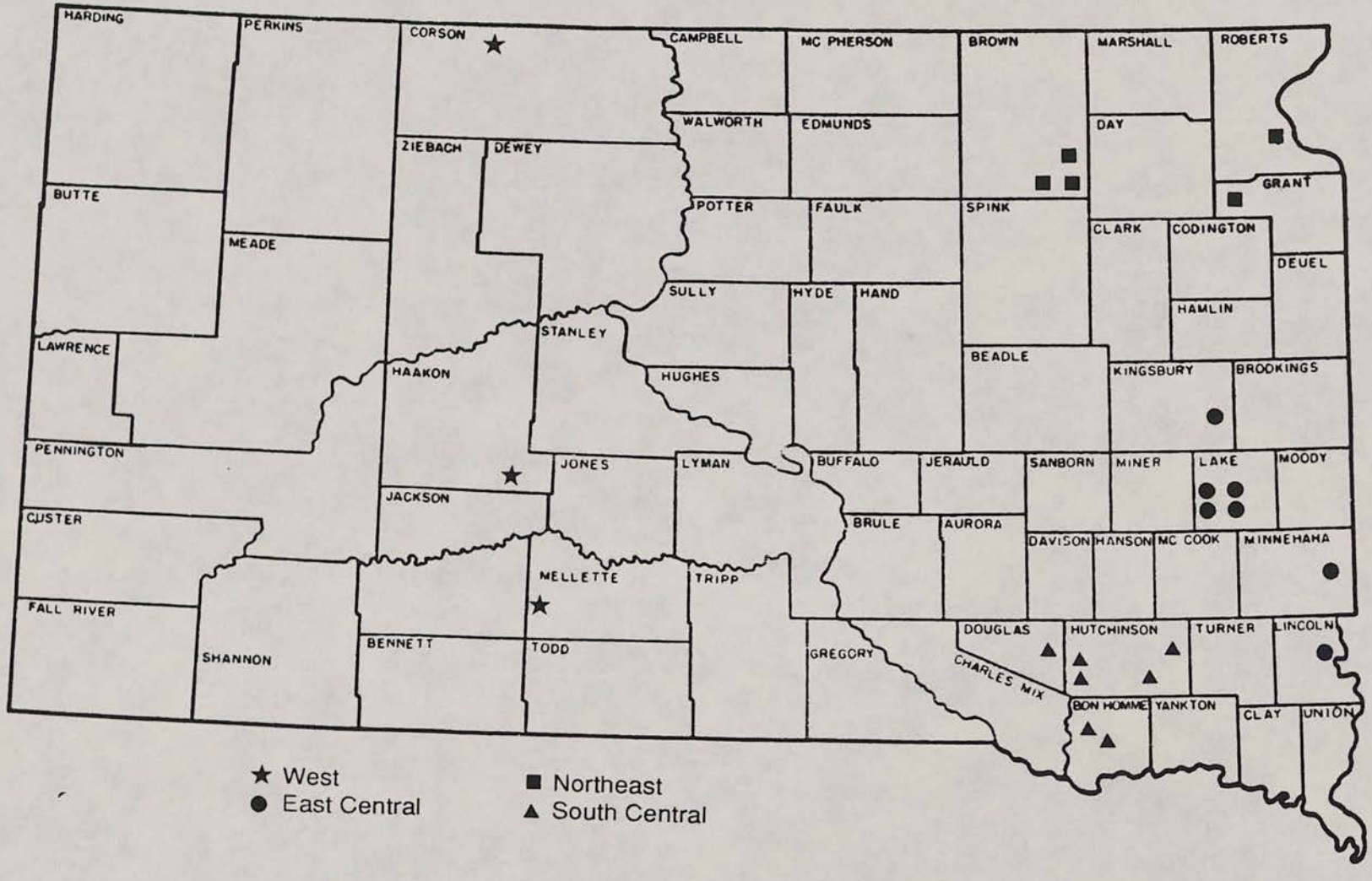

Table 1. Ages of boys and girls living at home, sustainable farms.[a]

Age range (years)	Boys		Girls	
	Number	Percent	Number	Percent
1 - 5	0.35	28.0	0.05	5.9
6 - 10	0.30	24.0	0.15	17.6
11 - 15	0.35	28.0	0.30	35.3
16 - 20	0.20	16.0	0.35	41.2
> 20	0.05	4.0	0	0

[a]The numbers of boys and girls shown below are average numbers of children (all less than an average of 1 child) in each age range category.

Table 2. Selected features of sustainable crop rotations, by region.

Rotation features	Region				State	
	South Central	East Central	North-east	West	No.	Percent[a]
Total number of rotations	7	7	5	3	22	100.0
Use of synthetic chemical fertilizers and pesticides						
On sustainable rotation crops						
Farmers using none	2	2	3	3	10	45.5
Farmers using some	1	3	1	0	5	22.7
Farmers with non-sustainably farmed cropland	4[b]	2	1	0	7	31.8
No. of rotations having selected features						
At least one small grain	7	7	5	3	22	100.0
Which small grains?						
Oats	4	6	3	2	15	68.2
Spring wheat	3	3	4	1	11	50.0
Rye	4	2	4	0	10	45.5
Millet	1	0	4	2	7	31.8
Winter wheat	1	0	1	2	4	18.2
Flax	0	2	2	0	4	18.2
Barley	0	2	0	0	2	9.1
Buckwheat	0	0	1	1	2	9.1
At least one row crop	7	7	5	1	20	90.9
Which row crops?						
Soybeans	6	6	5	0	17	77.3
Corn	5	7	2	1[c]	15	68.2
Sunflowers	0	0	2	0	2	9.1
Sorghum	1	0	0	0	1	4.6
Harvested legume forages						
Alfalfa	6	7	2	2[d]	17	77.3
Red clover	0	1	0	0	1	4.6
How forage legume is seeded						
Small grain nurse crop	5	7	4	2	18	90.0
Independently seeded	1[e]	0	0	0	1	5.0
Interseeded in corn	1	0	0	0	1	5.0
Inadequate information	0	0	0	1	1	n/a
Years alfalfa is left down						
1	0	2	0	0	2	14.3
2-3	1	2.5	0	0	3.5	25.0
4-5	3	1.5	1	1	6.5	46.4
6-7	2	0	0	0	2	14.3
Inadequate information	0	1	1	1	3	n/a
Summer fallow						
Black dirt	0	0	3	2	5	22.7
Cover crop	2	2	2	1	7	31.8
Sub-total	2	2	5	3	12	54.5

Approximate summer fallow intensity						
Once in 2 years	0	0	0	1	1	16.7
Once in 3 years	0	0	2	1[f]	3	50.0
Once in 4 years	0	0	0	0	0	0
Once in 5 years	0	0	0	1	1	16.7
Once in 6 years	0	0	0	0	0	0
Once in 7 years	1	0	0	0	1	16.7
Inadequate information	1	2	3	0	6	n/a
Cover crop, green manure						
During summer fallow						
Sweet clover	2	2	2	1	7	31.8
Forage sudan	1	0	0	1	2	9.1
At other times						
Sweet clover	1	1	0	1	3	13.6

[a]The percentages are calculated with respect to 22 in all cases except the fallow intensities (rather, with respect to a base of 6 applicable and known rotation lengths), the years alfalfa is left down (a base of 14), and how the forage legume is seeded (a base of 20).

[b]One farmer placed in this category occasionally spot sprays weeds; another occasionally sprays "problem areas" in his fields. [Neither sells their produce "organically."] Thus, they might be considered "borderline organic" on part of their land.

[c]Only 80 acres, or less than 1/10th, of this farmer's cropland are planted to corn.

[d]Only 20 acres, or less than 1/100th of one farmer's cropland, are planted to alfalfa.

[e]The alfalfa is broadcast in an August-planted crop of oats.

[f]The 7 year rotation underlying this "once in 3 year" fallowing intensity involves two summer fallows with fall seeding of wheat and a 7th year of complete land rest (under the cover of weeds that are allowed to mature before being plowed down).

Table 3. Selected cultural operations for major crops included in sustainable rotations.

	Row crops		Small grains			
Cultural operation	Corn	Soybeans	Oats	Spring wheat	Rye	Winter wheat
Number of observations	16	16	14	11	9	4
Number of field tillage operations						
Range among farmers	1-4	1-5	0-5	1-4	1-5	1-4
Average for all farmers	2.78	2.72	2.50	2.09	2.56	2.88
Percent of farmers undertaking fall tillage	56	44	50	64	n/a	n/a
Number of weed control operations						
Range among farmers	1-8	1-6	0-2	0-2	0-2	0-1
Average for all farmers	3.94	3.88	0.79	0.64	0.33	0.25
Percent of farmers using specific weed control practices						
Cultivation	94	94	0	0	0	0
Rotary hoe	50	56	0	0	0	0
Dragging, harrowing	44	38	43	36	33	25
Herbicide	25	19	29	27	0	0
Hand weeding	25	63	0	0	0	0
Total number of cultural operations						
Range among farmers	4-13	6-11	3-13	3-9	4-8	3-8
Average for all farmers	9.16	8.91	7.86	6.27	6.11	5.88

Table 4. Numbers and sizes of livestock operations, sustainable farms.

Type of livestock	Farms		Size of operation (head)	
	Number	Percent of 21	Mean	Range
Beef cows and calves	13	72.2	45	5 - 150
Cattle finishing	9	50.0	26[a]	8 - 300
Hog farrowing	5	27.8	17	8 - 45
Hog finishing	3	14.3	377	180 - 700
Dairy	1	5.6	60	60

[a]The average size for 8 cattle finishing operations is 26 head. The ninth cattle finisher feeds out 300 head. The average for the 9 producers is 57 head.

Table 5. Numbers of beef cows and calves, sustainable farms.

Size of herd category	Number of farms	Percent of farms with beef cows
5 - 24 cows	4	30.8
25 - 49 cows	5	38.5
50 - 74 cows	1	7.7
75 - 99 cows	2	15.3
100 - 150 cows	1	7.7
Total	13	100.0

Table 6. Roughages fed to beef cows, sustainable farms.

Percentage range	Type of roughage					
	Grazing		Hay		Silage/haylage	
	No. of farms	Percent	No. of farms	Percent	No. of farms	Percent
0 - 20	1	11.1	3	33.3	1	100.0
21 - 40	0	0	2	22.2	0	0
41 - 60	5	55.6	3	33.3	0	0
61 - 80	2	22.2	0	0	0	0
81 - 100	1	11.1	1	11.1	0	0
Total	9	100.0	9	100.0	1	100.0

Table 7. Percentage of cropland, over the period of a crop rotation, that receives manure applications, sustainable farms.

Percentage range	No. of farms	Percent
0 - 5	6	46.1
6 - 10	2	15.4
11 - 20	1	7.7
21 - 30	2	15.4
31 - 40	0	0
41 - 50	1	7.7
51 - 60	0	0
61 - 70	1	7.7
Total	13	100.0

Table 8. Sustainable farmer judgments on "best," "most normal," and "worst" crop production years.

Year	Number of farmers selecting each year as:[a]		
	Best	Most normal	Worst
1984	1	4	2
1985	1	4	1
1986	5	4	1
1987	7	2	0
1988	2	0	10
Unsure	6	9	6

[a]Some farmers cited more than one year as illustrative of each of "best," "most normal," and "worst" crop growing conditions.

Table 9. Sustainable farmer judgments on sustainable versus conventional corn and soybean yields, by crop growing condition and region, 1984-1988.

Sustainable versus conventional yield (% age range)	Number of responses, by region and type of year											
	South Central			East Central			Northeast			State		
	Best	Normal	Worst	Best	Normal	Worst	Best	Normal	Worst	Best	Normal	Worst
Corn												
11% or more higher	0	0	1	0	1	0	0	0	0	0	1	1
6 - 10.9% higher	0	0	0	0	0	0	0	0	0	0	0	0
1 - 5.9% higher	0	2	0	0	0	0	0	0	0	0	2	0
- 0.9% to + 0.9%	1	0	2	1	0	1	1	1	1	3	1	4
1 - 5.9% lower	0	0	0	0	0	1	0	0	0	0	0	1
6 - 10.9% lower	0	0	0	0	0	0	0	0	0	0	0	0
11 - 15.9% lower	2	1	0	1	1	0	0	0	0	3	2	0
16 - 20.9% lower	1	1	0	1	2	0	0	0	0	2	3	0
21% or more lower	0	1	0	1	1	1	0	0	0	1	2	1
Soybeans												
11% or more higher	0	1	0	0	0	0	0	0	0	0	1	0
6 - 10.9% higher	0	0	0	0	0	0	0	0	0	0	0	0
1 - 5.9% higher	1	0	0	0	0	0	0	0	0	1	0	0
- 0.9% to + 0.9%	1	2	2	0	0	2	1	2	3	2	4	7
1 - 5.9% lower	0	0	0	0	0	0	0	0	0	0	0	0
6 - 10.9% lower	0	0	0	0	0	0	1	0	0	1	0	0
11 - 15.9% lower	1	1	0	1	0	0	0	0	0	2	1	0
16 - 20.9% lower	0	0	0	0	2	0	1	0	0	1	2	0
21% or more lower	0	0	1	1	1	0	0	1	0	1	2	1

Table 10. Sustainable farmer judgments on sustainable versus conventional oat and spring wheat yields, by crop growing condition and region, 1984-1988.

Sustainable versus conventional yield (% age range)	Number of responses, by region and type of year														
	South Central			East Central			Northeast			West			State		
	Best	Normal	Worst	Best	Normal	Worst	Best	Normal	Worst	Best	Normal	Worst	Best	Normal	Worst
Oats															
11% or more higher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6 - 10.9% higher	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
1 - 5.9% higher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- 0.9% to + 0.9%	0	1	2	1	1	2	2	1	2	0	1	1	3	4	7
1 - 5.9% lower	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6 - 10.9% lower	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11 - 15.9% lower	2	1	0	1	0	0	0	0	0	0	0	0	3	1	0
16 - 20.9% lower	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1
21% or more lower	0	0	0	1	1	0	0	1	0	0	0	0	1	2	0
Spring wheat															
11% or more higher	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
6 - 10.9% higher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 - 5.9% higher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- 0.9% to + 0.9%	1	1	0	0	0	0	2	1	3	0	1	1	3	3	4
1 - 5.9% lower	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6 - 10.9% lower	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0
11 - 15.9% lower	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 - 20.9% lower	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21% or more lower	0	2	0	0	0	0	1	0	0	0	0	0	1	2	0

Table 11. Sustainable farmer judgments on sustainable versus conventional alfalfa yields, by crop growing condition and region, 1984-1988.

Sustainable versus conventional yield (% age range)	Number of responses, by region and type of year														
	South Central			East Central			Northeast			West			State		
	Best	Normal	Worst	Best	Normal	Worst	Best	Normal	Worst	Best	Normal	Worst	Best	Normal	Worst
11% or more higher	1	0	0	1	0	0	0	0	0	0	0	0	2	0	0
6 - 10.9% higher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 - 5.9% higher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- 0.9% to + 0.9%	1	3	1	0	2	1	1	1	1	3	3	3	5	9	6
1 - 5.9% lower	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
6 - 10.9% lower	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11 - 15.9% lower	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 - 20.9% lower	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21% or more lower	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 12. Crop insurance practices, sustainable farms.

Practice	Region				
	South Central	East Central	Northeast	West	State
% of farmers purchasing crop insurance	57	57	100	100	73
% of farmers purchasing crop insurance who purchase:					
Federal multiple peril insurance	75	100	100	100	94
Private hail insurance	25	25	20	33	25
Crops insured[a]	Soybeans corn wheat oats rye	Corn soybeans oats barley wheat	Wheat corn oats sunflower soybeans	Wheat oats corn	Wheat corn soybeans oats barley sunflower rye
% with Federal multiple peril crop insurance who:					
Elect the following coverage level:					
50%	0	50[b]	0	0	13
65%	75	50[b]	60	100	69
75%	0	0	20	0	6
Unsure	25	25	20	0	19
Elect the following price coverage:					
Low	0	50[c]	20	0	19
Medium	50	50[c]	20	100	50
High	0	0	40	0	13
Unsure	50	25	20	0	25
Number of years Federal crop insurance users have bought insurance					
Average	5	9	2	3	5
Range	1-16	1-28	1-8	1-4	1-28
% of farmers buying Federal crop insurance in 1989 who did so because of the 1988 Federal drought relief program	0	50	60[d]	60[e]	44
% of farmers ever trying to collect insurance on crop losses occurring on sustainably farmed land	100	67	50	100	75

[a]Crops are listed in order of the incidence of their being insured.

[b]One farmer elects 50% coverage for his small grain and 65% for his row crops.

[c]One farmer elects the low price coverage for his small grains and the medium coverage for his row crops.

[d]One farmer responded to the question "yes" for wheat but "no" for soybeans. This farmer was counted as responding "yes".

[e]One farmer responded "yes" for corn and "no" for oats and wheat. This farmer was counted as responding "yes".

Table 13. Sources of information to farmers about sustainable agriculture.

Information source	Frequency of response	
	Number	Percent
Other sustainable farmers	14	19.7
Own family experience	12	16.9
Sustainable farming books and magazines	11	15.5
Sustainable association newsletters	9	12.7
Non-university sponsored workshops, conferences,or farm tours on sustainable agriculture	9	12.7
Sellers of organic inputs	8	11.3
University extension and research personnel, university publications, or university sponsored workshops and tours on sustainable agriculture	4	5.6
Purchasers of organic products	4	5.6
Total	71	100.0

PART I
1989 SUSTAINABLE AGRICULTURE
PERSONAL INTERVIEW SURVEY
SOUTH DAKOTA STATE UNIVERSITY

Date _____ Schedule No. ___

Note: If more space is needed for any question, please write on the back side of the sheet.

1. Family Information

   a. Number in family, including you and your spouse (i.e., currently considered part of household for living expense and tax purposes):

   _____

   b. For children living at home, indicate how many of each type (boy or girl) according to age category:

   Boys ___ 1-5 ___ 6-10 ___ 11-15 ___ 16-20 ___ 20+

   Girls ___ 1-5 ___ 6-10 ___ 11-15 ___ 16-20 ___ 20+

Interviewee reactions to selected findings from mail survey study

2. The two most critical transition problems identified in the mail survey are (a) increased weed problems and (b) crops experiencing nitrogen shortages. If you were advising a farmer who is considering the possibility of shifting from conventional to regenerative farming how best to cope with these two problems, what would your advice be?

   a. Increased weed problems

   b. Crops experiencing nitrogen problems

3. One of the two most important continuing problems with regenerative agriculture identified collectively by the respondents is difficulty in finding markets for regeneratively-raised products. In your judgment, what are the two most important shortcomings in organic product marketing? For each, what do you see as most reasonable possible solutions?

4. The other most important continuing problem with regenerative agriculture identified collectively by the respondents is a lack of up-to-date and accurate information on regenerative agriculture.

   a. What are your most important sources of information on regenerative agriculture (check no more than 3-4 sources)?

   ___ Own family experience
   ___ Regenerative farming books and magazines
   ___ Regenerative association newsletters
   ___ University extension and research personnel, university publications, or university sponsored workshops and tours on regenerative agriculture
   ___ Non-university sponsored workshops, conferences, or farm tours on regenerative agriculture
   ___ Other regenerative farmers
   ___ Soil Conservation Service
   ___ Sellers of organic inputs
   ___ Purchasers of regenerative products
   ___ Other (_____)

   b. Are there any issues in regenerative agriculture on which you think it would be beneficial for the University to undertake research? Please briefly describe each.

   c. Do you have suggestions of how regenerative farmers, private organizations involved with regenerative agriculture, and university extension and research could communicate more effectively with each other?

5. Three of the four most important reasons indicated collectively by respondents for following regenerative practices involve the respondents being concerned about the implications of their farming practices for other people. Are you a regenerative farmer in spite of short-term adverse repercussions to you and your family? ___ yes ___ no. Or, do you believe you and your family are better off in the short-term than if you farmed conventionally? ___ yes ___ no. Please explain.

Policy

6. What changes (if any) would you like to see in the Federal farm program to make it more supportive or encouraging of sustainable agriculture practices?

7. Are there things you think State or local governments should do to encourage or require agricultural practices that are more sustainable?
_____ Yes _____ No
If Yes, explain:

8. Risk: In your judgment, does sustainable agriculture involve more or less risk than conventional agriculture to individual farmers?
_____ More _____ Less _____ No difference
If there is a difference, please explain why. And, is the risk greater during the transition than after the transition from "conventional" to "sustainable" agriculture?

Livestock

9. We are wanting to obtain an idea of the scale of your livestock operation(s). For each of the following livestock enterprises that you raise commercially, approximately how many animals did you have in a typical year during the 1984-1988 time period?

a. Beef cows-calves: number of cows that calved on your farm/ranch _____

b. Fat cattle (weighing 900 to 1,200 lbs. sold for slaughter)

- Number of animals sold _____

- Of those animals, how many did you:

* Raise yourself _____

* Purchase from others _____

* Feed on contract from others _____

c. Dairy cows: number of cows that freshened _____

d. Hog farrowing: (1) no. of breeding sows that farrowed _____

(2) average no. of farrowings/sow/yr _____

(3) no. of times per year that you farrow _____

e. Hog finishing:

(1) Number of slaughter hogs sold _____

(2) Of these animals, how many did you:

- Raise yourself _____

- Purchase from others _____

- Feed on contract from others _____

10. Do you use confinement facilities (closed buildings, concrete) with your livestock enterprises? ___ yes ___ no. If so, for which enterprises, and for each what is the general nature of the confinement facility?

11. Do you use all the manure produced by your livestock enterprises on your regeneratively farmed cropland and pasture? ___ yes ___ no

a. Do you purchase livestock manure from others? ___ yes ___ no If so, approximately what percentage of the manure that you use do you purchase? ___%

b. If you could find additional supplies of manure, would you probably be interested to buy it? ___ yes ___ no. Please explain why.

c. What proportion of your cropland, over the period of a crop rotation, receives manure applications? ___% On that land, after about how many years do you typically repeat manure applications? ___ years

12. We are wanting to obtain an idea of the types of feeds used with your livestock operations. For each livestock operation, please indicate the approximate (rough dry matter basis) percentages used of each feed source.

	Beef cow calf	Fat cattle	Dairy cows	Hog farrow	Hog finish
Grazing	____	____	____	____	____
Hay	____	____	____	____	____
Silage (haylage)	____	____	____	____	____
High moisture grain	____	____	____	____	____
Dry grain	____	____	____	____	____
Protein supplement	____	____	____	____	____
TOTAL	100%	100%	100%	100%	100%

13. Other than protein supplements, do you purchase any of these feedstuffs from others? If so, for each such enterprise(s), about what proportion of each such feedstuff is purchased?

a. Beef cow calf -

b. Fat cattle -

c. Dairy cows -

d. Hog farrow -

e. Hog finish -

14. Do you consider that you raise your livestock with regenerative practices? Yes ___ No ___ If yes, what is different about your livestock management practices from those who raise livestock conventionally? If not, what would you have to do differently in order to be a regenerative livestock producer? (If the space below is too little, please write on the back side.)

PART II
1989 SUSTAINABLE AGRICULTURE
PERSONAL INTERVIEW SURVEY

Date _____ Schedule No. _____

South Dakota State University

15. On your mail survey form, you listed _____ total acres of "cropland"--including set-aside, fallow, and that currently being used as hay and pasture. You also listed the following two crop rotations (A and B) as the main ones being followed on your regeneratively farmed land; please fill in the blanks below for those rotations and the rest of your cropland:

Cropland use	Acres in 1988 (to the nearest 10 or 20)
Rotation A. (_____, _____, _____, _____, _____, _____, _____, _____)	_____
Rotation B. (_____, _____, _____, _____, _____, _____, _____, _____)	_____
Other crops or rotations (e.g., continuous corn, corn and soybeans, etc.; describe and indicate whether or not farmed "regeneratively"):	
C. (_____)	_____
D. (_____)	_____
E. (_____)	_____
F. (_____)	_____
Total cropland (fill in from mail survey)	_____

Is any of the cropland irrigated? ___ Yes ___ No

If yes, which crops or rotations and how many acres?

16. Circle which of the regenerative rotations listed you consider to be your principal one: A B

If other than the one with largest acreage, indicate why you indicated that one: _____

_____

17. For the principal rotation, please answer:

a. What are the principal soil series on these fields? _____

_____

b. Describe slope conditions. _____

_____

c. How much of this land is rented? _____ acres

d. If rented, on what basis (circle one or both)? cash shares

e. If owned, how and when acquired? _____

f. Indicate sequence, number of years in rotation, and form of crop removal or use (grain, silage, hay, grazing, plow down as green manure, etc.) for each crop in the principal regenerative rotation:

	Crop (in sequence)	No. of years in rotation	Form of crop removal or use (indicate if more than one)
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____

g. If non-legumes are used as cover crops, why?

h. If alfalfa stand is for 1 year only, why?

18. For each crop (including fallow) in the principal regenerative rotation, please describe cultural practices in a "typical" year--using the following format (report in sequence indicated in response to 17, f).

Cultural practices for crop: _____

In the operation column, fully describe any tandem hookup operations.
Include irrigation operations, if part of this crop rotation.
Enter all hired operations and the cost of hiring.
For chemical fertilizers and pesticides, manure, and similar inputs, enter full descriptions of levels and rates of application.
For rotations with forage legumes, be sure to note how the forage legume is established.

Operation/Implements used	Times Over	Date (Month)	Hired application or other custom cost	Quantities of chemicals, manure, etc. per acre[2]
Spring pre-plant:				
Manure, compost, chemical fertilizer, organic fertilizer, organic waste products (e.g. leaves) and/or other soil amendment inputs used:				
Synthetic chemical pesticides (herbicides, insecticides, etc.) and/or biological control measures used:				
Planting:				
Cultivation, hand weeding, mowing, irrigation:				
Harvest (including grazing):				
Post-harvest tillage or other operations in Summer or Fall:				

[1]Determine if this cost includes the cost of fertilizers, pesticides, etc., or just the application cost.

[2]Determine if the rate per acre includes all ingredients or just the amount of "active" ingredients applied.

19. In this question, we would like to obtain estimates of your regenerative yields--and those of "conventional" farming neighbors who have similar land and moisture conditions. Please refer to the principal regenerative rotation reported in questions 17 and 18. Over the last 5 years (1984-1988), try to think of a "most normal" year from the standpoint of growing conditions, as well as the "best" and the "worst" year.

"Most normal" year: _____ Growing conditions: _____

_____

"Best" year: _____ Growing conditions: _____

_____

"Worst" year: _____ Growing conditions: _____

_____

Historical yields for your major crops (including forage legumes) grown "regeneratively" with limited or no synthetic chemical fertilizers and with limited or no other synthetic chemical inputs.

Crops (in same sequence as in #3, e)	Your yield and comparison to typical neighbor using conventional practices on similar land and with similar moisture. If other than bu./ac., indicate units.					
	"Most Normal" Year		"Best" Year		"Worst" Year	
	Yours	Neighbors	Yours	Neighbors	Yours	Neighbors

20. Government farm program

a.

Crop	Base Acres*	Base Yield*
Corn		
Wheat		
Oats		
Barley		
Sorghum		
Other? ( )		

*Indicate if the base acres (as a proportion of cropland) and yields are different for the part of your farm with the principal regenerative rotation.

b. Since 1984, have you generally participated in acreage set-aside and commodity payment provisions of the Federal farm program?

_____ Yes _____ No (If no, skip to part e.)

c. If Yes, usually at the minimum required set-aside levels or often at higher levels? Explain:

d. How do your set-aside acres fit into your regenerative rotations?

e. If no, why don't you participate?

f. If you are participating in the 1989 farm program, do you plan to substitute soybeans or sunflowers on 10-25% of a program crops permitted acres? ___ Yes ___ No

21. Conservation compliance

a. Do you have land which must meet special "conservation compliance" provisions of the 1985 Federal Farm Bill? ___ Yes ___ No

b. If Yes

(1) How many acres of the land you farm does this apply to? _____

(2) What are the location(s), legal description(s), and soil and slope characteristics of the field(s) involved?

(3) What measures have you taken -- or do you plan to take -- to come into compliance?

(4) Are those measures compatible with the kinds of "regenerative" ("sustainable") practices you would like to use anyway?

c. Describe any other soil and water conservation practices (i.e., sod waterways, terraces, shelter belts, etc.) and their importance in your operation.

22. Crop Insurance

a. Do you purchase crop insurance? ___ Yes ___ No

If Yes (1) What form do you purchase?

___ Federal multiple peril crop insurance

___ Federal limited peril commercial hail/fire insurance

___ Private hail insurance

(2) Which crops do you insure?

(3) If Federal insurance, what level of coverage do you generally insure for?

___ 50% ___ 65% ___ 75%

(4) If Federal insurance, what price election do you generally choose?

___ low ___ medium ___ high

(5) For how many years have you been buying Federal crop insurance?

_____

(6) Have you tried to collect insurance on crop losses that occurred on sustainably farmed land? ___ yes ___ no. If yes, have you ever had any problems collecting insurance on losses due to using sustainable agricultural methods? ___ yes ___ no. If yes, please explain.

b. Is the 1988 Federal drought relief program the reason you are purchasing Federal crop insurance for the 1989 crop year? ___ Yes ___ No ___ NA

23. Other Sources of Income

a. In a typical year, approximately what percentage of your adjusted gross income (e.g., I.R.S. Form 1040, Line 31) is derived from:

(1) the farm _____

(2) off farm employment _____

(3) other (stocks, bonds, other investments, etc.) _____

Total 100%

b. Who is employed off the farm?

___ husband ___ wife ___ other

c. What is the nature of your off farm employment?

24. Farm Management and Labor

a. What is your form of farm organization? ___ Sole proprietorship ___ Partnership ___ Family held corporation ___ Other (_____)

b. Approximately what percentage of the total labor performed on your farm is

(1) provided by you and your family _____

(2) hired outside the family _____

Total 100%

c. What tasks are performed by your hired labor?

d. In what way are major management tasks shared among family members and perhaps others?

25. Custom Work

a. Do you perform custom work for other farmers? ___ Yes ___ No

If yes: (1) What types of work?

(2) How many days/year (for each type)?

b. Do you hire custom work to be done for you? ___ Yes ___ No

If yes: (1) What types of work?

(2) How many days/year (for each type)?

26. Farmer-specific questions that arose from their mail survey responses.

ANNEX 2

SUSTAINABLE CROP ROTATION COMPONENTS AND MANAGEMENT PRACTICES

SOUTH CENTRAL REGION

Rotation A. Corn - Soybeans - Corn - Rye or Oats with alfalfa seeded in the fall - Alfalfa (4-5 yr)

About 310 acres are in this rotation. On the average, roughly 140 acres of corn, 65 acres of oats, 75 acres of soybeans, and 30 acres of alfalfa are planted each year. An additional 50 acres are in a Corn-Soybean rotation.

Some chemicals are used on the corn, soybeans, and oats. The chemicals are used only as needed and generally only on rented ground.

He establishes alfalfa in the fall following the harvest of his oats. A second crop of oats is planted in August/September through broadcasting and one follow-up discing. Immediately thereafter, he broadcasts alfalfa seed and drags the fields twice. The oats, of course, provide a cover crop going into the winter for the alfalfa.

To keep volunteer corn out of soybeans, the rotation may be Corn-Oats-Soybeans. Alfalfa, which is left down for 4-5 years, is usually not planted on rented ground.

Rotation B. Winter Wheat - Soybeans - Corn interseeded with sweet clover or alfalfa - Sweet Clover Summer Fallow or Alfalfa (3-5 yr)

This is the 4 year rotation toward which this farmer is working. He has 840 acres of cropland, with 300 acres receiving some chemical use.

The sweet clover is interseeded either right after planting corn or at the last cultivation. The sweet clover is used as a green manure crop the next year. A new alfalfa field may also be started in a similar manner. However, the alfalfa is left down for 3-5 years.

Rotation C. Corn - Grain Sorghum (Milo) or Rye - Corn - Soybeans or Oats seeded with sweet clover or alfalfa - Alfalfa (3-5 yr)

This farmer has 540 acres of cropland. In 1988, he planted 330 acres of corn, 60 of acres oats, 60 acres of soybeans, 30 acres of alfalfa, and 60 acres were in set- aside.

Due to a large corn base, he will sometimes plant grain sorghum after corn to avoid having corn on corn. Alfalfa is planted with oats and is left down for 3-5 years. He has started planting rye again for its weed control and good quality straw.

Rotation D. Soybeans - Spring Wheat

This farmer's total cropland of 260 acres is divided about equally with one-half wheat and the other half soybeans. He may experiment in the future with some corn, as the Soybeans - Spring Wheat rotation has caused the ground to loosen up a bit. If he does plant corn, he would go with one-half the acres in soybeans and the other half in a spring wheat-corn combination.

The farmer's other rotation involves an additional 120 acres of rented land, where he has one-half corn and one-half split between soybeans and spring wheat. He uses some chemicals and fertilizers on the corn.

He has a compost pile where people from town can come and dump their leaves and grass clippings. The compost is applied on the wheat stubble in the fall.

A mixture of spring wheat and sweet clover is planted on the farm program set-aside acres.

Rotation E. Corn - Oats - Corn - Oats - Corn - Oats seeded with alfalfa - Alfalfa (5-8 years)

This farmer's 450 acres of cropland are divided so that about one-third are in each of oats, corn, and alfalfa. The alfalfa is left down for 5-8 years. Corn is usually planted on newly broken alfalfa land. Alfalfa is established with oats as a nurse crop.

The farmer intends to plant 40 acres of soybeans in 1989. Seventy acres of land is irrigated and this is currently planted to alfalfa. Liquid manure from dairy cows provides the majority of the nitrogen.

Rotation F. Corn - Oats seeded with sweet clover or alfalfa - Sweet Clover green manure or Alfalfa (7 yr) - Millet - Spring Wheat - Rye - Sweet Clover and Forage Sudan Land Rest

This farmer follows no set rotation on his 160 acres of cropland. The crops above do not necessarily follow each other in that order. He has four 40-acre fields at the present time.

He plants crops based on market signals and on what he feels. In 1989, he will have 80 acres of oats, 40 acres of rye, 40 acres of spring wheat, and he may experiment with a small amount of lupine.

The farmer also has 185 acres of pasture and alfalfa. The alfalfa is in the rotation for about 7 years and then moved to a new location. The pasture is down for 15-20 years. Over a period of time, the alfalfa and pasture are moved around the entire farm.

One year in 7 all the land is rested. [Last year is the fourth time he has rested his land during the 7th year.] No crops are harvested. Sweet clover and forage sudan are used as cover crops during the 7th year of rest.

Rotation G. Spring Wheat - Soybeans with a fall sowing of rye - Rye - Soybeans - Rye seeded with alfalfa - Alfalfa (3 yr)

This farmer has about 265 acres of cropland. In 1989, he will have about 110 acres of rye, 90 acres of soybeans, 20 acres of wheat, and 45 acres of alfalfa.

He is still looking for the rotation that fits his operation best, particularly from the standpoints of meeting the needs of both soil fertility and weed control. With this in mind, he is currently trying the Soybeans - Rye rotation (above), where rye is planted in the fall after soybean harvest.

Alfalfa is broadcast during the spring in the rye crop and is generally left down for 3 years. The spring wheat after alfalfa is something new he is trying in 1989.

EAST CENTRAL REGION

Rotation H. Soybeans - Corn - Small Grain (Oats, Spring Wheat, or Barley) seeded with alfalfa - Alfalfa (1 yr)

This farmer's 685 acres of cropland are each year divided about equally among the 4 components in the rotation.

Alfalfa is seeded with the small grain. The alfalfa is only left down for 1 year after being established. Alfalfa provides excellent weed control and, by leaving it in for 1 year, he can move the alfalfa to other fields quicker. If alfalfa is left in for more than 1 year, it will deplete the subsoil moisture. Because soybeans require less water than corn, they--rather than corn--follow alfalfa.

Rotation I. Soybeans - Corn - Oats seeded with alfalfa - Alfalfa (1 yr)

This farmer's 490 acres of cropland are divided so that each year one-fourth of the area is used for each of the 4 crops. Alfalfa is established with oats as a nurse crop. Leaving alfalfa down for 1 year provides "fantastic" weed control.

Rotation J. Corn - Spring Wheat or Oats seeded with sweet clover or alfalfa - Sweet Clover Summer Fallow, Soybeans, or Alfalfa (3-5 yr)

This farmer sometimes, but not always, follows this rotation on his 270 acres of cropland. He will be renting an additional 300 acres in 1989.

The sweet clover and soybeans may not always be planted. He would then have a Corn - Small Grain - Small Grain - Corn rotation. Soybeans were first planted in 1988.

The sweet clover and alfalfa are established with oats as a nurse crop. Alfalfa is left down for 3-5 years.

Rotation K. Flax or Soybeans - Spring Wheat or Corn - Corn, Barley, or Spring Wheat seeded with Sweet Clover - Soybeans - Corn - Barley seeded with Alfalfa (3 yr)

About 250 acres of this farmer's cropland are in this sustainable rotation. Another rotation, in which fertilizer and herbicides are used, involves 250 acres of Corn - Barley - Soybeans. Overall, the farmer generally plants about 100 acres of corn, 95 acres of barley, 45 acres of wheat, 145 acres of alfalfa, and 115 acres of soybeans and/or flax.

This rotation allows some flexibility for responding to varying conditions of soil nutrient depletion and weed pressure. Alfalfa is usually left down for 3 years, and gets moved around most of the cropland. Sweet clover could also be seeded with the wheat and used as set-aside acres the next year.

Rotation L. Soybeans - Corn - Oats seeded with sweet clover or alfalfa - Sweet Clover Summer Fallow

This is the farmer's main rotation for his 1,060 acres of cropland (1,280 in 1989). An Alfalfa - Flax - Rye rotation also dovetails into this rotation on part of his land. Rough annual acreages are 380 acres of corn, 240 acres of oats, 120 acres of sweet clover, 170 acres of soybeans, 60 acres of flax, 50 acres of alfalfa- brome, and 40 acres of alfalfa.

The rotation is not followed rigidly. Alfalfa is seeded with oats. If a field of pasture or alfalfa is plowed up, flax is usually planted and then followed with rye. The government programs importantly influence what is planted. Trying to keep a rotation and not give up any corn base can be very difficult.

He uses minimum amounts of chemicals on one-third of his land.

Rotation M. Corn - Soybeans - Oats seeded with red clover or alfalfa - Red Clover (1 yr) or Alfalfa (2-3 yr)

This farmer has 700 acres of cropland. Ideally, he would like one-fourth of his land to be in each crop, but participating in the farm program does not always allow this to happen. Red clover is down 1 year after being established with oats, and alfalfa is left down for 2-3 years.

Rotation N. Corn - Oats sometimes seeded with alfalfa - Rye - Alfalfa (3-4 yr)

This is the general pattern of rotation for this farmer's 57 acres of cropland. When starting a new field, alfalfa is seeded with oats. The alfalfa is normally left down for 3-4 years. The crop after alfalfa could be oats or corn--depending on the moisture (with dry conditions, oats; with wet, corn).

Rye is planted in the fall after oats. The next year it could be plowed down as a green manure crop or harvested in July for grain. If it is a wet spring, the rye might be plowed down and planted to corn. If it is a dry spring, the rye may be harvested as grain or hay and planted to oats the next year. What is planted depends a lot on the weather.

CROP ROTATIONS, NORTHEAST REGION

Rotation O. Millet or Oats - Summer Fallow - Spring Wheat - Soybeans - Corn - Spring Wheat or Oats seeded with alfalfa - Alfalfa

This rotation is sometimes, but not always, followed on this farmer's 520 acres of cropland. His crops are generally split as follows: 100 acres of wheat, 150 acres of corn, 50 acres of soybeans, 30-40 acres of alfalfa, 30-40 acres of millet, and 150 acres are in summer fallow.

Planting is often based on a "gut feeling," with the amount of moisture being an important determining factor. Millet tends to be planted on previous spring wheat ground that was not seeded with alfalfa. Oats may be planted on newly broken alfalfa land and then summer fallowed after the oats.

Rotation P. Sweet Clover Summer Fallow with the fall seeding of rye - Rye - Spring Wheat - Soybeans - Spring Wheat - Corn - Oats seeded with sweet clover

In this farmer's rotation of 1,400 cropland acres, he generally plants about 350 acres of wheat and 350 acres of soybeans. The balance is split among the other crops. On an additional 200 acres, he plants soybeans after soybeans.

The farm program, moisture, and weed conditions will determine which of the other crops are raised. The farmer only owns 187 acres of cropland. Maintaining a desired rotation on rented land can be difficult. Ideally, he would like a 7 year rotation where 2 years are soybeans, 2 years are wheat, 1 year is fallow, and 2 years are in minor crops such as corn, oats, and rye.

He uses near conventional amounts of chemicals and fertilizer on most crops.

Rotation Q. Summer Fallow with the fall seeding of winter wheat or rye - Rye or Winter Wheat - Soybeans - Sunflowers - Millet

This farmer is working toward this rotation on 175 acres of his sustainably farmed cropland. About 155 acres are also in a Soybeans - Soybeans - Wheat rotation, where there is some chemical use.

The farmer's first year to raise rye was 1988; so, he's still trying to see how rye will fit into the rotation. He does not follow a strict rotation. He looks at each field and decides which crop will do best--based on factors such as moisture, weed control, and prospective market prices.

Rotation R. Spring Wheat seeded with sweet clover - Sweet Clover Summer Fallow - Spring Wheat - Spring Wheat seeded with rye - Sunflowers, Soybeans, Millet, Flax, or Rye

This farmer's rotation of 746 cropland acres is built around a 500 acre wheat base. He generally plants 70-80 acres of sweet clover (seeded with spring wheat) and uses this as set-aside for the government program the next year. Depending on particular conditions, the remaining acres (approximately 200) are planted to some combination of sunflowers, soybeans, millet, flax, and rye.

Rotation S. Summer Fallow - Soybeans - Spring Wheat or Oats - Millet - Summer Fallow with a fall seeding of rye or millet - Millet or Flax seeded with alfalfa - Alfalfa (3-5 yr)

This farmer's 800 cropland acres are divided so that about one-third are in each of summer fallow, legumes (soybeans and alfalfa), and small grains (e.g., wheat, oats, millet, flax, buckwheat).

If moisture is adequate over the first 3 years of the rotation, he plants millet or flax instead of summer fallow in the 4th year. He then summer fallows the 5th year. This has been done about 50% of the time. In 1989, instead of tilling fallow land to control weeds, he is experimenting with several close rotary mowings of the weeds. By avoiding fallow land tillage and keeping the weeds mowed short, he believes he may be more successful in conserving soil moisture.

During the year of summer fallow, he plants rye in the fall if there is adequate moisture. The rye is plowed down as green manure in the spring. He views the allelopathic, heavy-tillering, and wide-shading properties of rye to be especially helpful in controlling weeds. If moisture is inadequate to put rye on the summer fallow, however, he plants millet for winter cover.

Alfalfa is usually established with the flax or millet and left as alfalfa for 3-5 years. After breaking out the alfalfa, the land is summer fallowed for 1 year. The primary reason for this practice is to allow a build up in the soil moisture supply to replace that which has been depleted from several years of alfalfa production.

CROP ROTATIONS, WEST REGION[1]

Rotation T. Buckwheat - Summer Fallow with a fall seeding of winter wheat - Winter Wheat - Millet - Summer Fallow with a fall seeding of winter wheat - Winter Wheat

This farmer's 2,575 cropland acres is roughly divided one-third each in winter wheat, buckwheat or millet, and summer fallow. However, the 2,575

---

[1]If conditions are right, all 3 of these West region farmers may take a seed crop from their alfalfa.

acres include 20 acres of alfalfa, which is usually left down, after establishment, for 5 years.

All the owned acres (755) are idled every 7th year. During that year, the weeds mature and go to seed on the idled acres. He believes that weeds, as they mature, draw up plant nutrients from the soil. These minerals become embodied in the weed plant tissue and, when incorporated into the soil, will become available to the following year's crops. There is no summer fallow on owned land during the 6th year.

The farmer intends to try seeding clover with the grain crops as an added source of nitrogen and organic matter. He may also experiment with amaranth.

Rotation U. Oats seeded with sweet clover - Millet with a fall seeding of winter wheat - Winter Wheat - Summer Fallow with a fall seeding of winter wheat - Winter Wheat - Oats seeded with alfalfa - Alfalfa (5 yr)

This farmer is working toward this rotation on his 1,050 cropland acres. In 1988, he had about 240 acres winter wheat, 190 acres of summer fallow, 265 acres of millet, 300 acres of alfalfa, and 55 acres of wheat grass.

After breaking up a field of alfalfa, oats are usually planted. If it is too wet to plant oats, he waits and plants millet. He is going to try oats with sweet clover to add nitrogen for next year's winter wheat or millet crop. In the 2nd year, if there is not enough moisture for winter wheat, he will wait and plant millet the following year.

He is working at building up the organic matter of his soil by getting away from summer fallowing. In 1989, he plans to experiment with 32 acres of mung beans.

Rotation V. Corn - Forage Sudan Summer Fallow - Oats seeded with sweet clover - Sweet Clover Summer Fallow - Spring Wheat seeded with sweet clover - Sweet Clover Summer Fallow

This farmer has 900 acres of rotated cropland and 100 acres of permanent alfalfa. In 1988, he had about 460 acres fallow, 250 acres of spring wheat, 110 acres of oats, and 80 acres of corn.

In any one year, he has about 50% cropland and 50% fallow. On the summer fallow following oats and wheat, he has sweet clover for a green manure crop. On the summer fallow following corn, he raises forage sudan as a green manure crop. The sudan is raised because he can't seed sweet clover in the corn like he can in the small grains. He has about 100 acres of alfalfa, but the alfalfa is permanent and not part of the rotation.

ANNEX 3

CULTURAL OPERATIONS FOLLOWED IN SUSTAINABLE CROP ROTATIONS

NOTE: Some of the rotations in Annex 3 are listed differently from those in Annex 2. This is because some crops are included more than once in a rotation. For example, a rotation such as this may be listed in Annex 2: Corn - Soybeans - Corn - Oats - Alfalfa. If the cultural practices are the same for both corn crops, corn would be listed only once in Annex 3.

Rotation A.

Cultural practice	Number of times the cultural practice is performed				
	Corn	Soybeans	Rye	Oats	Alfalfa (Fall seeded)[a]
Pre-plant land preparation					
Field cultivate and drag	1				
Tandem disc and drag		1	1	1	
Fertilizer, manure, and pesticide application					
Broadcast spreader				1	
Planting					
Drill			1	1	
Planter w/harrow on front	1	1			
Weed control					
Rotary hoe	1-2	1-2			
Cultivate	2	1-2			
Spray herbicide	1	1[b]		1	
Bean buggy		1			
Harvest					
Swather			1	1	3
Bale			1	1	3
Chop silage	1				
Combine	1	1	1	1	
Ear picker	1				
Post-Harvest					
Broadcast spreader					2
Tandem disc					1
Drag					2
Spread manure				1	
Offset disc			1	1	
Chisel plow	1		1	1	

[a]In establishing his alfalfa, he broadcasts oats and discs them in. They provide a cover crop going into the winter for the alfalfa seed which is broadcast and later dragged twice. These cultural practices take place the same year the oats are seeded.

[b]Custom sprayed.

South Central

Rotation B.

Cultural practice	Number of times the cultural practice is performed				
	Corn	Sweet clover summer fallow	Alfalfa	Winter wheat	Soybeans
Pre-plant land preparation					
Tandem disc	1				1
Field cultivate	2				2
Planting					
Drill				1	
Planter	1				1
Broadcast seed and drag (sweet clover or alfalfa)	2				
Weed control					
Drag			2		1-2
Rotary hoe					1-2
Cultivate					2
Hand weeding	1				1
Harvest					
Swath		1	2	1	
Bale			2		
Combine	1	1		1	1
Post-Harvest					
Manure spreader				1	
Tandem disc		2	2	1	
Field cultivate		1		1	
Noble blade		1	1	1	
Chisel plow				1	

South Central

Rotation C.

Cultural practice	Number of times the cultural practice is performed							
	Corn	Grain Sorghum (milo)	Rye	Corn	Soybeans	Oats w/ Sweet Clover	Oats w/ Alfalfa	Alfalfa
Pre-plant land preparation								
Moldboard plow	1							
Tandem disc	1	1	1	1	1	1	2	
Field cultivate	1	1		1	1			
Drag (harrow)			1			2	5	
Fertilizer, manure, and pesticide application								
Manure spreader	1	1	1	1				1
Broadcast fertilizer						1		
Planting								
Planter	1	1		1	1			
Broadcast seed			1			1	2	
Weed control								
Rotary hoe	1	1		1	1			
Cultivate	2	2		2	2			
Spray herbicide	1	1		1				
Harvest								
Windrow (swather)			1			1	1	
Combine	1	1	1	1	1	1	1	3
Bale			1			1	1	3
Post-Harvest								
Chisel plow	1	1		1				

South Central

Rotation D.

Cultural practice	Number of times the cultural practice is performed			
	Soybeans	Spring wheat	Corn	Spring Wheat and sweet clover on set aside
Pre-plant land preparation				
Chisel plow w/sweeps	1			
Chisel plow with sweeps and drag		1	1	
Tandem disc			1	
Drag	1			
Fertilizer, manure, and pesticide application				
Broadcast fertilizer			1	
Planting				
Drill		1		1
Planter	1		1	
Weed control				
Drag	1	1	1	
Cultivate	1-2		2	
Hand weeding	1			
Spray herbicide		1	1	
Harvest				
Swather		1		
Combine	1	1	1	
Post-Harvest				
Manure spreader		1		
Moldboard plow		1		1
Chisel plow w/sweeps	1			
Plowing disc			1	

South Central

Rotation E.

Cultural practice	Number of times the cultural practice is performed			
	Oats	Corn	Oats on Set aside to establish alfalfa	Alfalfa
Pre-plant land preparation				
Tandem disc	1		1	
Noble blade		1		
Planting				
Planter		1		
Drill	1		1	
Weed control				
Rotary hoe		1		
Cultivate		2		
Spray herbicide	1	1		
Harvest				
Swath	1			3-4
Combine	1			
Chop	1	1		1
Bale	1			3
Picker shell		1		
Post-Harvest				
Noble blade	1-2	1		2[a]
Liquid manure knife in	1	1		
Stalk chopper			1	
Tandem disc		1		

[a]Used when breaking ground.

South Central

Rotation F.

Cultural practice	Number of times the cultural practice is performed						
	Corn	Oats with sweet clover or alfalfa	Sweet clover	Alfalfa (after oats)	Millet	Spring wheat	Rye
Pre-plant land preparation							
Offset disc	2-3				2-3		
Tandem disc		1				1	
Field cultivate and drag		1			1	1	
Offset disc and drag							1
Chisel plow w/sweeps							2
Planting							
Drill		1			1	1	1
Planter	1						
Weed control							
Cultivate	3						
Hand weed	1						
Drag		1			1	1	
Harvest							
Swather		1		2-3	1	1	1
Corn picker	1						
Combine		1			1	1	1
Bale				2-3			
Post-Harvest							
Spread manure		1					
Chisel plow		2	2			2	
Chisel plow w/sweeps				2[a]			2
Offset disc			1				

[a]Used when breaking ground.

South Central

Rotation G.

Cultural practice	Number of times the cultural practice is performed				
	Soybeans	Rye	Rye with alfalfa	Alfalfa	Spring wheat
Pre-plant land preparation					
Tandem disc	2	1	1		1
Field cultivate	1				
Planting					
Broadcast spreader			1		
Drill		1	1		1
Planter	1				
Weed control					
Harrow		1	1		
Cultivate	2				
Harvest					
Swather				2-3	
Bale				2-3	
Combine	1[a]	1	1		1
Post-Harvest					
Manure spreader	1				
Offset disc		1		2[b]	1

[a]Custom combined.

[b]Used when breaking ground.

East Central

Rotation H.

Cultural practice	Number of times the cultural practice is performed			
			Small Grain	
	Soybeans	Corn	Oats, spring wheat or barley	Alfalfa
Pre-plant land preparation				
Tandem disc and drag	1-2	1	2	
Field cultivate and drag	1	1		
Planting				
Drill			1	
Planter	1	1		
Weed control				
Rotary hoe	1-2	1		
Cultivate	3	3		
Hand weed	1			
Harrow		1	1	
Harvest				
Swath			1	3
Combine	1	1	1	
Bale			1	3
Post-Harvest				
Manure spreader			1	
Tandem disc		1		
Chisel plow				1
Chisel plow w/sweeps				2

East Central

Rotation I.

Cultural practice	Number of times the cultural practice is performed			
	Alfalfa	Soybeans	Corn	Oats with alfalfa
Pre-plant land preparation				
Disc and drag		1	1	
Disc				2
Field cultivate		1	1	
Planting				
Drill				1
Planter		1	1	
Weed control				
Rotary hoe		1	1	
Cultivate		2	2-3	
Hand weeding		1		
Drag			1	1
Harvest				
Swath	3			1
Bale	3			1
Combine		1	1	1
Post-Harvest				
Chisel plow	1			
Chisel plow w/sweeps	1			
Disc			1	

East Central

Rotation J.

Cultural practice	Number of times the cultural practice is performed				
	Corn	Soybeans	Spring wheat or oats with sweet clover or alfalfa	Sweet clover summer fallow	Alfalfa
Pre-plant land preparation					
Chisel plow	2	1			
Field cultivate		2			
Tandem disc			1		
Planting					
Drill			1		
Planter	1	1			
Melroe drag	1				
Weed control					
Cultivate	2	2			
Spray herbicide		1[a]	1		
Harvest					
Swath			1	1[c]	1-2
Bale			1	1[c]	1-2
Combine	1	1[b]	1	1[c]	
Ear corn picker	1				
Post-Harvest					
Moldboard plow		1		1	1[d]
Spray on Basic-H and agriserum	1	1	1	1	1
Disc to incorporate Basic-H and agriserum	1	1	1	1	
Chisel plow agriserum and Basic-H	1				

[a]Custom sprayed.

[b]Custom combined.

[c]These practices apply if he takes a seed crop.

[d]Used when breaking ground.

East Central

Rotation K.

Cultural practice	Number of times the cultural practice is performed						
	Alfalfa	Flax	Soybeans	Spring wheat	Corn	Barley w/alfalfa or with sweet clover	Sweet clover on idle acres after spring wheat
Pre-plant land preparation							
Disc and drag		1	1	1	1		
Disc				1	1	1	
Chisel plow						1	
Drag			2		1-2	1	
Pick rock[a]			1				
Fertilizer, manure, and pesticide application							
Broadcast spreader				1		2	1[b]
Planting							
Drill		1					
Planter			1		1		
Weed control							
Rotary hoe			1				
Cultivate			2		1-2		
Hand weed			1		1		
Harvest							
Swath	3	1		1		1	
Bale	3					1	
Combine		1	1	1	1	1	
Post-Harvest							
Moldboard plow	1[c]						1
Chisel plow		1	1	1		1	

[a]Sometimes when soybeans are hand weeded, rocks are picked up.

[b]Barley used for winter cover.

[c]Used when breaking ground.

East Central

Rotation L.

Cultural practice	Number of times the cultural practice is performed							
	Corn	Oats with sweet clover	Sweet clover (harvest for seed)	Sweet clover summer fallow	Soybeans	Alfalfa (established with oats)	Flax	Rye
Pre-plant land preparation								
Field cultivate	1							
Tandem disc and drag		1						
Disc				2	1		1	1
Fertilizer, manure, and pesticide application								
Broadcast spreader								1
Planting								
Drill		1					1	
Planter	1				1			
Weed control								
Drag	1				1			
Rotary hoe	1				1			
Cultivate	2-3				3			
Hand weeding					1			
Harvest								
Swath		1	1			2-3	1	1
Bale						2-3		
Combine	1	1	1		1		1	1
Post-Harvest								
Haul manure		1				1[a]		
Chisel plow					1		1	1
Moldboard plow						1[b]		
Disc			1				1	

[a]Applied in winter.

[b]Used in breaking ground.

East Central

Rotation M.

Cultural practice	Number of times the cultural practice is performed				
	Corn	Soybeans	Oats	Red Clover	Alfalfa
Pre-plant land preparation					
Field cultivate w/sweeps	1	1			
Tandem disc and drag		1	1		
Fertilizer, manure, and pesticide application					
Broadcast spreader			1-1[a]	1	1
Planting					
Planter	1	1			
Weed control					
Drag	1	1	1		
Rotary hoe	1	1			
Cultivate	3	3			
Harvest					
Swath				2	3
Bale				1	3
Combine	1	1	1	1	
Post-Harvest					
V-chisel plow (Ripper)		1		1	1[b]
Tandem disc	1-2				1[b]

[a]Custom seeded.

[b]Used when breaking ground.

East Central

Rotation N.

Cultural practice	Number of times the cultural practice is performed						
	Corn	Oats	Rye harvested for grain	Rye (green manure crop)	Corn (after green manure rye)	Oats if rye harvested for grain	Alfalfa
Pre-plant land preparation							
Moldboard plow	1				1		
Disc	1	2	1	1	1	2	
Fertilizer, manure, and pesticide application							
Spread manure	1				1		
Planting							
Drill		1	1	1		1	
Planter	1				1		
Weed control							
Drag	3-4	2	2	2	3-4	2	
Rotary hoe	1				1		
Cultivate	2-3				2-3		
Hand weed	1				1		
Harvest							
Sickle mow							3
Rake							3
Loose hay bucker							3
Ear corn picker	1				1		
Swath		1	1			1	
Combine		1	1			1	
Bale		1				1	
Post-Harvest							
Field cultivate w/sweeps		1					

Northeast

Rotation O.

Cultural practice	Number of times the cultural practice is performed					
	Soybeans	Corn	Spring wheat or oats	Alfalfa	Millet	Summer fallow
Pre-plant land preparation						
Tandem disc and harrow	2-3	2-3	1-2		1-2	
Tandem disc						3
Planting						
Pony press			1		1	
Lister planter	1	1				
Weed control						
Harrow	1	2	1			
Cultivate	1-2	2-3				
Hand weeding	1					
Harvest						
Swath	1		1	3	1	
Bale				3		
Combine	1	1	1		1	
Post-Harvest						
Moldboard plow				1[a]		
Tandem disc	1					

[a]Used when breaking ground.

Northeast

Rotation P.

Cultural practice	Number of times the cultural practice is performed						
	Sweet clover summer fallow	Rye	Spring wheat	Soybeans	Spring wheat	Corn	Oats
Pre-plant land preparation							
Moldboard plow	1						
Field cultivate	2		2	3	1	3	2
Pickup rock			1	1	1	1	1
Offset disc		1					
Chisel plow		1					
Fertilizer, manure, and pesticide application							
Broadcast fertilizer	1[a]		1[a]	1[ab]	1[a]	1[ab]	1[a]
Apply manure	1						
Planting							
Drill		1	1	1	1		1
Planter						1	
Weed control							
Cultivate						1-2	
Spray herbicide			1[c]		1[c]		1[c]
Harvest							
Swath							1
Combine		1	1	1	1	1	1
Post-Harvest							
Offset disc						1	1
Chisel plow			1-2	1	1-2		1

[a]Custom fertilized.

[b]Herbicide is applied with the broadcast liquid fertilizer.

[c]Custom sprayed.

Northeast

Rotation Q.

Cultural practice	Number of times the cultural practice is performed				
	Summer fallow	Rye or winter wheat	Soybeans	Sunflowers	Millet
Pre-plant land preparation					
Field cultivator	6-7	1			
Field cultivator and drag			1-2	1-2	2-3
Tandem disc		2		1	
Fertilizer, manure, and pesticide application					
Manure spreader	1				
Planting					
Planter			1	1[a]	
Drill		1			1
Weed control					
Melroe drag		1	1-2	1	1
Cultivate			2	2	
Hand weeding			1		
Rotary hoe				1	
Harvest					
Swath					1
Combine		1[b]	1[b]	1[b]	1
Bale		1			1
Post-Harvest					
Tandem disc				1	

[a]Custom planted.

[b]Custom combined.

Northeast

Rotation R.

Cultural practice	Number of times the cultural practice is performed						
	Spring wheat with sweet clover	Sweet clover summer fallow	Spring wheat	Rye	Flax and millet	Sunflowers	Soybeans
Pre-plant land preparation							
Moldboard plow						1	1
Drag						1	1
Tandem disc		1		1			
Planting							
Planter						1	1
Pony press	1		1		1		
Drill				1			
Weed control							
Rotary hoe						1	1
Cultivate						2	2
Hand weed						1	1
Harvest							
Swath	1		1	1	1		
Combine	1[a]		1[a]	1	1	1[a]	1[a]
Post-Harvest							
Noble blade			1[b]	1	1		
Tandem disc			1[b]				

[a]Custom combined.

[b]Under dry conditions, he uses the noble blade; with wet conditions, the tandem disc.

Northeast

Rotation S.

Cultural practice	Number of times the cultural practice is performed						
	Summer fallow	Soybeans	Spring wheat	Millet	Summer fallow with rye	Flax with w/alfalfa	Alfalfa
Pre-plant land preparation							
Tandem disc	1	1	1	1	1		
Chisel plow	2			2	2		
Drag		1					
Moldboard plow							1[e]
Fertilizer, manure, and pesticide application							
Manure spreader	1				1		
Planting							
Drill				1			
Pony press			1[d]		1	1	
Planter		1[b]					
Field cultivate and drill			1[d]				
Weed control							
Cultivate		2					
Rotary mower	1[a]			1	1		
Harvesting							
Swath				1			1
Combine		1[c]	1	1		1	1
Bale			1	1			
Post-Harvest							
Manure spreader			1				

[a]This is not done when alfalfa ground that has been plowed is summer fallowed.

[b]Custom planted.

[c]Custom combined.

[d]Half the acres may be drilled and half may be pony pressed. When pony pressed, no discing is done.

[e]Used when breaking ground.

West

Rotation T.

Cultural practice	Number of times the cultural practice is performed			
	Summer fallow	Winter wheat	Millet and/or buckwheat	Alfalfa[a]
Pre-plant land preparation				
Field cultivate with sweeps	4-5		1-2	
Offset disc		1		
Planting				
Hoe drill		1	1	1
Harvest				
Swath			1	1-2
Bale				1
Combine		1[b]	1[b]	1

[a]Alfalfa is grown continuously on land separate from his sustainable crop rotation. The alfalfa is seeded in the fall, after winter wheat harvest, with oats as a nurse crop. When an occasional seed crop is taken, the alfalfa is swathed a second time and then combined.

[b]Custom combined.

West

Rotation U.

Cultural practice	Number of times the cultural practice is performed					
	Oats	Alfalfa	Millet	Winter wheat after millet	Summer fallow	Winter wheat after summer fallow
Pre-plant land preparation						
Chisel plow	2		2	1		
Chisel plow with sweeps and drag	1					
Disc			1			
Chisel plow with sweeps			1-2	1-2	7	
Planting						
Shovel drill	1		1	1		1
Press drill		1				
Harrow			1			1
Harvest						
Swath	1	1-2[a]	1			
Bale		1				
Combine	1	1[a]	1	1		1
Post-Harvest						
Chisel plow	1			1		1

[a]Alfalfa is swathed a second time and combined only when a seed crop is taken.

West

Rotation V.

Cultural practice	Number of times the cultural practice is performed						
	Corn	Sudan grass summer fallow	Oats	Sweet clover summer fallow	Spring wheat	Sweet clover summer fallow	Alfalfa (permanent)
Pre-plant land preparation							
Offset disc	1-2	1					
Chisel plow							1[a]
Tandem disc and harrow							1[a]
Planting							
Field cultivate with sweeps, harrow and drill			1		1		
Planter	1						
Drill		1					
Weed control							
Cultivate	3						
Harvest							
Chop silage	1						
Ear corn picker	1						
Swath			1		1		1-2[b]
Haybuster stacker							1
Combine			1		1		1[b]
Post-Harvest							
Offset disc		1-2		1-2		1-2	

[a]Once every 3 years.

[b]Alfalfa is swathed a second time and combined only if a seed crop is taken (approximately every 2 years out of 10).

ANNEX 4

SUSTAINABLE LIVESTOCK MANAGEMENT PRACTICES

In this annex, the management practices of the 13 farmers who (1) consider themselves to raise their livestock sustainably and (2) described the practices that they follow are indicated first,[1] followed by the practices for the 2 farmers who use a combination of sustainable and conventional practices. The nature of the applicable livestock enterprise(s) is indicated prior to the description of each farmer's management practices. In reporting these practices, the research team is not implying that any or all of the practices are necessarily associated with the reduced presence of chemical residues in livestock meat or that other claims of the farmers are necessarily "true".

FARMERS WHO VIEW THEMSELVES TO RAISE LIVESTOCK SUSTAINABLY

Beef cow-calf. In general, I use no antibiotics in my feed, no hormones, and no vaccinations. If I sell heifers, however, I give them Bangs vaccinations. The cattle are fattened mainly with grass and hay, rather than with grain. These practices result in less disease.

Beef cow-calf. I give the calves their 7-way vaccination at branding time. The calves are not touched again until they are weaned in late November, at which time they receive a second 7-way vaccination. The calves are held off their mothers for 6 weeks. They are then allowed to go back to their mothers until calving time next spring. When calving is complete, they may join their mothers again, or be sent to another pasture. I have found that yearlings allowed to run with older cattle, their mothers, are much quieter and seem to gain better than when separated.

Beef cow-calf. I produce 100% organic beef. I use no chemicals, no feed additives, no stimulants, no antibiotics, and no off-farm non-organic grain. Instead of the usual 3 or 4 acres per cow and calf, I allow 6 acres. I use no confinement buildings and rely on superior bovine genetics. I use intense hands-on daily management practices and rely on God's blessings to be economically viable. [As with grain production, there can be no middle ground. There's no such thing as "<u>more</u>" sustainable.]

Beef cow-calf. I use no medicated feeds, no sprays, and no vaccines. I rotate my pastures to keep livestock from grazing the pastures too short. This prevents the livestock from picking up any soil-borne diseases or particles.

Beef cow-calf. I use no hormones and all my feed is raised organically.

Beef cow-calf and cattle finishing. The cattle are fed grain raised on ground that is 15 years removed from chemicals. They receive no shots, no antibiotics, no drugs, and no growth promotants.

Beef cow-calf and cattle finishing. I use no feed additives except for free

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[1]A 14th sustainable farmer considers himself to raise livestock sustainably, but he did not describe the sustainable practices that he uses with his livestock.

choice mineral and salt.

Beef cow-calf and hog farrowing. Confinement facilities are not used. We provide natural birthing facilities, i.e., on pasture or in the barn. All feedstuffs are organically grown. We use no growth stimulants, no synthetic feeds, no pour-on insecticides, and no hormones.

Beef cow-calf and hog farrowing. All feed is raised with a minimum amount of chemicals and pesticides. [They say you are what you eat. If this is true, which product would you eat--one organically grown or one raised with chemicals?]

Cattle finishing, hog farrowing, and hog finishing. The grain is higher in protein and contains less chemical residue. Hay is substituted for silage. I farrow in an old barn and finish my hogs on concrete that leads from a sheltered shed. I do not use closed confinement facilities.

Dairy. We use probiotics, feed more silage, and give no hormones. The cows have free stall housing during adverse weather.

FARMERS WHO CONSIDER THEMSELVES TO USE BOTH SUSTAINABLE AND CONVENTIONAL PRACTICES

Beef cow-calf, cattle finishing, hog farrowing, and hog finishing. I do not use any growth stimulants. I use very little, if any, drugs in the feed and give very few shots. I previously used confined finishing for hogs, but now am going to an open front type of finishing. Farrowing is done in pens with sows turned out on concrete for feeding.

Hog farrowing and finishing. We still use conventional vaccinations and medicines. We use antibiotics in finishing rations and some medications in early weaning rations. Our feed grains are home grown, which means most of the corn and oats are organic. During gestation, our sows are kept outside on dirt lots, with calf huts for shelter. They are given free choice alfalfa, fed as bales on the side. Farrowing is in an enclosed building, with cement floors and insulated walls and ceiling. We use farrowing pens, exhaust fans, and some supplemental heat. Starter pigs are kept in an old horse barn, with a cement floor and partition huts to help the pigs stay warm. Finishing hogs are fed outside on a feeding floor. All hogs, from farrow to finish, are straw-bedded.

ANNEX 5

ADVICE OF SUSTAINABLE FARMERS ON HOW TO DEAL WITH TRANSITION WEED PROBLEMS

The advice of sustainable farmers, through the personal interview survey, for dealing with transition weed problems is reproduced almost verbatim in this annex. The responses are arranged by region.

South Central Region

1. Sweet clover is good for mellowing the ground and eliminating pigeon grass. Working the ground after harvesting wheat helps to control weeds that might otherwise go to seed.

2. We have not experienced weed problems largely because of crop rotations, deep and timely field tillage, and greater plant populations for canopy to shade out weeds.

3. For broadleaf weeds, plant small grain and till as yet immature weeds after harvest. For grasses, delay row crop planting until early June so that you can till in grass growth at least 3 times prior to planting. To control both types of weeds, plant alfalfa and leave it down for 3 years.

4. Try not to plant extra early. Rotary hoe approximately every 7 days after planting. Also, don't plant only row crops. This will give you more time to take care of your land.

5. I would give 2 solutions, depending on the farmer's preference. First, if you can afford it, you should determine mineral deficiencies in the soil and add those minerals necessary to bring into proper balance the minerals in your soil. Alternatively, you could wait a few years and let the weeds and the crop rotation balance the soil.

6. We plant later.

East Central Region

7. Drop the word "weed," from your vocabulary and use "prairie plants" instead. The prairie was here before we tried to farm the ground. Every year it tries to reestablish itself. Some plants I formerly thought of as weeds I've now learned to live with. For the unwanted "prairie plants" (e.g., cocklebur, thistle, sunflower, velvet leaf), I purchased a C.D.A. sprayer, allowing me to spray at one-half the rates with good control. Hopefully, I'll be ably to wean myself of all chemicals.

8. Sweet clover as a seed crop cleans up the ground well. Rye is an excellent crop for choking out weed problems. Timing is very important when using tillage to control weeds. Also, use a strong legume rotation.

9. Follow crop rotations having alfalfa and other legumes, compost manure to eliminate weed seeds, plant later than normal, use the rotary hoe, and be timely in your cultivations.

10. Pay close attention to the timing of cultivation in row crops. Be sure that initial tillage is deep and thorough enough to kill all weeds. Alfalfa is essential to weed control in rotations. Finally, you should farm less ground.

11. Start a rotation program with small grain, alfalfa, soybeans, and corn. Don't try to be the first farmer in the field in the spring.

12. I recommend continued use of some chemicals for a period. Mixing the chemicals with vegetable oil permits reduced amounts of chemicals to continue to be effective.

13. A good rotation with alfalfa is very effective in reducing weed problems.

Northeast Region

14. Increased weed and nitrogen shortage problems are interrelated. They arise because the soil is having withdrawl symptoms, exactly the same as a drug addict having his supply taken away. The only answer is to allow time and nature to clean it up and restore the balance and fertility. I recommend planting alfalfa and grass with millet or buckwheat the first year. I would then leave it in hay at least 5 years. Clipping weedy areas and burning thistle patches with a torch, between hay cuttings, helps to ensure that you stop producing weed seed. Then, I would break out the alfalfa and allow the field to be summer fallowed to replenish soil moisture. The 7th year, one is ready to start an organic rotation. I would start with wheat, then soybeans, summer fallow, wheat, and back to alfalfa.

15. Plant an early crop (e.g., oats, wheat) one year and a later crop (e.g., soybeans, sunflowers) the next year. For row crops, drag and cultivate to control weeds.

16. Follow a summer fallow program where you can clip or mow weeds before they go to seed.

17. Use a crop rotation and mechanical means to control weeds.

18. Weeds like acid soils. Fertilizers and herbicides both contain acid.

West Region

19. Weeds are an indicator of soil, timing, or plant density problems. In a biodynamic farm, you plant row crops wide enough to cultivate and follow a rotation that breaks the weed growth pattern. If weeds become a severe problem, they may have to be plowed down before going to seed.

20. We use a mineral fertilizer. If we get enough moisture to dissolve and activate the trace mineral into the soil, we have very good weed control.

21. Use crop rotations.

ANNEX 6

ADVICE OF SUSTAINABLE FARMERS ON HOW TO DEAL WITH TRANSITION NITROGEN SHORTAGES

The advice of sustainable farmers, through the personal interview survey, for dealing with transition nitrogen shortage problems is reproduced almost verbatim in this annex. The responses are arranged by region.

South Central Region

1. I would suggest using legumes like sweet clover or alfalfa in the rotation. On a more permanent basis, I would try to build the organic matter and humus content of the soil.

2. Sweet clover, alfalfa, and soybeans should be part of the rotation.

3. We rotate every other year with a legume. This legume is sometimes plowed down at its maximum growth state, rather than harvested.

4. We use alfalfa in our rotation and plow down or knife in liquid manure from the dairy operation.

5. Use legume hay in your rotation, plant crops that require less nitrogen, and precede all grass-type crops with a legume.

6. Try to plant more legumes and set realistic yield goals.

East Central Region

7. You should rotate crops, using alfalfa and soybeans. Proper tillage, to incorporate residue, is important. This can be achieved with a disc and/or chisel plow.

8. Alfalfa and green manure crops are good sources of nitrogen. You can also use manure from your livestock, your neighbors' livestock, and perhaps other sources.

9. Follow a good crop rotation, leave all the residue on the land, and do not leave the ground bare in the summer. Earthworms can also help.

10. Nitrogen can be added by (a) using a legume and small grain rotation and (b) adding manure.

11. Rotate more legumes and use manure. This is still a problem for me, especially in corn. The Government Program forces me into maintaining my corn base for economic reasons. Maybe this year, with the change in rules, I'll be able to get back to the rotation that would be optimum for my farm.

12. A good crop rotation--with alfalfa, sweet clover, and soybeans--can replace commercial nitrogen.

13. You should use a 28-0-0 fertilizer until soil life can support a crop without adding nitrogen.

8. It can be difficult to get the organic buyers' schedules to match farmers' marketing schedules. This can create cash-flow problems. As a farmer, you have to make extra forward plans for marketing since you can't take a load of organic grain to town whenever you need some money.

9. I feel we have to de-emphasize getting more for organic products and rather promote sustainable agriculture on the basis of its value to soil life, slowing erosion, reducing hard pan (compaction), and preserving water quality. These objectives can be achieved without a reduction in yield, and in most cases with an input savings to the farmer.

10. Shipping distance to organic market buyers is a problem. It would be nice to be able to deliver to local elevators.

11. We should not let one nationwide group sell our production. We need to have storage on the farm, as organic crops are usually bought only when buyers are ready to make final deliveries of product.

12. If South Dakota had an agency that would label products grown organically, that would be a big help. Since levels of chemical residues in food are open to debate, we would also have to test organic products to ensure no excess chemicals are present.

Northeast Region

13. Delays occur between the time an organic producer markets his grain and when he usually receives his check. Having to store one's grain until the buyer is ready for it imposes a burden on producers for providing storage facilities and can generate cash-flow problems for them.

14. It takes time, but organic markets can be found. One should contact businesses directly or contact brokers.

15. You have to wait a while after you market your grain before you receive your check. This can cause cash-flow problems.

16. Finding markets for organic produce is not a problem.

17. People in the U.S. don't understand what chemicals are doing to our food. We need to better educate people about the advantages of organically grown food.

West Region

18. It can be difficult, but it is not impossible, to get your foot in the door of organic markets. The best way is to become involved in the different sustainable agriculture organizations. They can provide information on potential organic market outlets. Another method is to write letters to distributors of organic foods inquiring about market possibilities for your produce. The addresses can be obtained by going to health food stores and looking at food packages. The markets are out there. You have to work hard to find them.

ANNEX 7

SUSTAINABLE FARMER JUDGMENTS ON SHORTCOMINGS IN ORGANIC PRODUCT MARKETING

This annex covers the individual responses of the 21 personally interviewed sustainable farmers on important shortcomings in organic product marketing and possible solutions to the problems. The responses are arranged by region.

South Central Region

1. One problem relates to the proximity of organic buyer cleaning facilities. This could be solved by developing other organic grain terminals. Another problem deals with buyer integrity. There should be some kind of rating or evaluation of organic product purchasers.

2. The biggest problem is demand. The consumer needs to know that organic products are better in health and nutrition. A second problem is the high cost of organic products to the consumer. Because organic products are cheaper to produce, they should be also to sell. Processors, packagers, and retailers are price gouging.

3. We need more of a market for our products. One example is organic beef. I sell a small amount locally. It would be nice to capture the market in Europe, especially with their ban now on beef treated with growth hormones.

4. One problem is people's belief that they should always be able to buy cheap and sell high. To solve this, we should teach people how everyone, except the big money people, would benefit from a parity or balanced economy. The other problem is that the little extra organic price premium is hardly worth the extra effort and cost that goes into marketing organically. A solution would be to raise the price premiums.

5. We need a definition of "organic," and better organization and information.

East Central Region

6. A sustainable farmer usually has to wait after harvest before he can sell and make delivery of his organic produce. This could be solved by having the buyer purchase on contract the product before or during harvest. Any extra storage and interest costs should be the buyer's expense. Second, the organic price premiums should be made more consistent, with a wider spread over conventional market prices. This might be achieved through more stringent and strongly enforced certification rules.

7. At present, there are uncertainties on when organic buyers will need commodities. As a result, long-term storage of organic commodities on farms is often necessitated. Not only must the producer bear the costs of storage, but also the burden of uncertain and uneven cash-flow. Second, the market for some organically-produced crops (e.g., corn) is very thin relative to the amount of commodity produced. Work on developing markets, not only for large volume commodities like corn, but also for organic beef, would be very helpful.

8. It can be difficult to get the organic buyers' schedules to match farmers' marketing schedules. This can create cash-flow problems. As a farmer, you have to make extra forward plans for marketing since you can't take a load of organic grain to town whenever you need some money.

9. I feel we have to de-emphasize getting more for organic products and rather promote sustainable agriculture on its value to soil life, slowing erosion, reducing hard pan (compaction), and preserving water quality. These objectives can be achieved without a reduction in yield, and in most cases with an input savings to the farmer.

10. Shipping distance to organic market buyers is a problem. It would be nice to be able to deliver to local elevators.

11. We should not let one nationwide group sell our production. We need to have storage on the farm, as organic crops are usually bought only when buyers are ready to make final deliveries of product.

12. If South Dakota had an agency that would label products grown organically, that would be a big help. Since levels of chemical residues in food are open to debate, we would also have to test organic products to ensure no excess chemicals are present.

Northeast Region

13. Delays occur between the time an organic producer markets his grain and when he usually receives his check. Having to store one's grain until the buyer is ready for it imposes a burden on producers for providing storage facilities and can generate cash-flow problems for them.

14. It takes time, but organic markets can be found. One should contact businesses directly or contact brokers.

15. You have to wait a while after you market your grain before you receive your check. This can cause cash-flow problems.

16. Finding markets for organic produce is not a problem.

17. People in the U.S. don't understand what chemicals are doing to our food. We need to better educate people about the advantages of organically grown food.

West Region

18. It can be difficult, but it is not impossible, to get your foot in the door of organic markets. The best way is to become involved in the different sustainable agriculture organizations. They can provide information on potential organic market outlets. Another method is to write letters to distributors of organic foods inquiring about market possibilities for your produce. The addresses can be obtained by going to health food stores and looking at food packages. The markets are out there. You have to work hard to find them.

19. We need distribution channels into the public sector. This might be achieved through supermarkets. Also, the general public finds organic foods to be tasteless. This is due to food processing without sugar or salt. Organic foods can spoil because no preservatives are used. We need to provide a food that the public likes for about the same price as non-organic foods.

20. I am already officially "certified organic" and am connected with the Northern Plains Sustainable Agriculture Society. This has helped me discover organic market outlets with good prices for my crops.

ANNEX 8

SUSTAINABLE FARMER JUDGMENTS ABOUT POTENTIAL ISSUES FOR RESEARCH ON SUSTAINABLE AGRICULTURE

The suggestions by sustainable farmers of issues on sustainable agriculture with potential promise for research are reproduced almost verbatim in this annex. Responses dealing with crops, soils, insects, and weeds are first presented, by region. Other responses follow.

Crop, Soil, Insect, and Weed Research

South Central Region

1. SDSU could be very helpful in studying different rotations with the idea of learning what maintains and builds good soil fertility and controls weeds. More research should be undertaken on open-pollinated varieties of corn. It would be good to know if there is more feed and nutritional value for livestock in open-pollinated corn.

2. SDSU should look into the impacts of giving land a 3-7 year rest ("soil banking"), breeding plants for disease resistance, and the results of soil compaction on root growth.

3. There should be research into possible non-toxic methods of grasshopper control and other biological pest and weed control methods.

4. Research could be done on edible crops (e.g., different types of beans) for this part of the country. Another area to investigate would be soil building crops that could be interseeded or fall-planted to produce nitrogen and control erosion (e.g., vetch, clover, winter peas).

5. Conduct field trials with crop rotations that do not use fertilizers and other chemicals.

East Central Region

6. I would like to see some research done on the biological aspects of the soil. Is modern agriculture interfering with beneficial soil microbial populations? Would a high earthworm population have a postive effect on the soil? Do farm chemicals and acid-treated fertilizers have a negative effect on life in the soil? Long-term sustainable crop yields are only possible by recognizing the fundamental importance of soil microbiology.

7. We should continue the on-going nutrient and biotic life monitoring of the soils. Does organic farming draw down nutrient levels in the soil?

8. The university should research a soil management program that promotes life in the soil, slows erosion, and preserves water quality.

9. Continue research in University test plots on sustainable agriculture.

Northeast Region

10. We should treat sustainable agriculture in a more realistic manner. This can be done by moving to larger scale field plots that are managed in the same way a farmer manages his own fields.

11. We should be working on ensuring the future generations of the earth the capability of producing food for themselves to eat.

12. The university should study the control of weeds and pests without using chemicals.

13. Some test-plot research should be undertaken comparing conventionally farmed ground with ground treated with organic inputs.

West Region

14. A review of soil structure to plant life could be valuable. Also valuable would be a study of how to build and maintain soil structure for efficient absorption of water and resistance to wind erosion. It would be helpful to have information on interseeding legumes with cereal and row crops.

15. There should be a monitoring system set up to enable my farm to be compared with a conventional farm in my area. You could compare such things as organic matter, nitrogen, and trace minerals.

16. The university should study open-pollinated varieties of seed corn and different crop varieties raised sustainably.

Other Topics

17. There should be some research on investment in capital items. For example, you could compare two farms, with the same acres, to determine differences in their machinery inventories and costs. The organic farmer's harvesting costs are spread over more crops and seasons. The conventional farmer has all his acres in row crops and needs larger machines to get the crop in. Also, how can producers, on a practical level, make the switch from conventional to sustainable agriculture? We should establish tested methods and approaches on how to make the change.

18. The relationship between alternative farming methods and groundwater contamination needs to be examined.

19. The effects of farming on chemical contamination of the soil and water need to be studied.

20. We need to find markets for organic products. This may be done by educating the people and changing their attitudes about organic products.

21. Research should be undertaken to help farmers in purchasing organic inputs and in marketing organic produce.

22. We need to thoroughly analyze differences in beef grown organically with that produced conventionally (e.g., with hormones).

23. The university should do some testing of organic inputs.

24. North Dakota's verified organic agriculture needs to be studied.

ANNEX 9

SUSTAINABLE FARMER SUGGESTIONS ON COOPERATIVE WORKING RELATIONSHIPS AMONG FARMERS, PRIVATE ORGANIZATIONS, AND UNIVERSITIES CONCERNING SUSTAINABLE AGRICULTURE

The suggestions by sustainable farmers on possible cooperative working relationships among farmers, private organizations, and universities concerning sustainable agriculture are reproduced almost verbatim in this annex.

1. We need to stay open-minded about agriculture, and not dismiss one way as being better than another.

2. The university staff should become interested in sustainable agriculture and seek communication.

3. Broad-minded people should be hired at universities.

4. We should all try to not have prejudices and work for the same goal.

5. The county extension agents could help by looking into sustainable agriculture with an open mind.

6. I think that SDSU is moving in the right direction. Instead of just saying it won't work, as you have in the past, find out what does work and improve on it.

7. Extension personnel should be more open-minded about sustainable farming.

8. Annual winter workshops, with co-sponsorship among various groups and universities, would be helpful. We could also establish an advisory board consisting of active producers who meet and work with SDSU personnel.

9. Conduct meetings where farmers and researchers can get together and share ideas.

10. Seminars could be held on sustainable agriculture, much like those presently being held on conventional crop and livestock production.

11. What SDSU is doing right now is good.

12. First, stop mistaking agribusiness for agriculture. Then, start talking (publishing) about agriculture, instead of sounding like a modified commercial for the chemical companies.

13. This survey is one good example. We could conduct annual updated surveys and monitor the information. Another idea is on-farm research and summmer farm tours. The university could put together a monthly newsletter and send it to interested parties.

14. Our extension service could be the distribution and collection medium for information on the local level through computer networking. I believe the extension service has been cut and is threatened due to a lack of need, since

many conventional farmers get their information for farming techniques from ag input companies. Since sustaintable farming is not dependent on outside inputs, the extension service could be instrumental for education and information distribution services.

15. Some kind of central agency could be used to improve communication, possible a federally funded branch of the USDA.

Annex 10

SUSTAINABLE FARMERS BETTER OR WORSE FROM FOLLOWING SUSTAINABLE PRACTICES?

	Are you a regenerative farmer in spite of short-term adverse repercussions to you and your family?		Are you and your family better off in the short-term, than if you farmed conventionally?		Explanation
	Yes	No	Yes	No	
South Central Region	x			x	I believe in the past I would have made more money using chemicals to farm. I also believe that there is a point in time where the advantage turns to organic farming. We, on our farm, may have reached that point now.
			x		I believe in being a good steward of the soil and in taking care of the earth. I feel our health is better, for not using chemicals.
	x		x		We have been better off financially in the short and long term. This is because we have low inputs, used equipment, and ambition. This requires long hours and some manual labor but not more stress, so that is not adverse.
			x		Our father used crop rotations and clover to build the soil, so we continued the practice. We do occasionally have adverse effects but they are on a field by field basis only.
	x		x		This is hard to answer since I can see no justification for further pollution of soil and water. What price is the future worth?
			x		I don't have the big yields or big gains. But I don't have the big loss when things go bad (drought or hail).
East Central	x		x		"Better off" involves more than economics to me.
	x			x	My wife and I felt there had to be a better and safer way to farm. Our health and ground water should be better without chemical residue in our food and water supply.
			x		You have to be pragmatic with farming. Plan ahead and do what works.

- cont. -

	Are you a regenerative farmer in spite of short-term adverse repercussions to you and your family?		Are you and your family better off in the short-term, than if you farmed conventionally?		Explanation
	Yes	No	Yes	No	
			x		Not just short term, but long term also. Conventional farming practices are causing compaction, erosion, and water pollution. If farmers don't change, consumers are going to legislate change.
			x		Financially, the price premiums help. I have respect for the land. I feel I have a moral obligation to the land, rather than farming the land to get the maximum return.
			x		Our family made the switch to regenerative farming in the mid 70's. We took risks and had failed results, but also some rewarding successes. As each year goes by, the results get better. We took come ridicule, some back-stabbing, some indifference by landlords, and shaking heads by some neighbors. Most of that is no longer there.
	x		x	x	Economically, I am worse off than if I'd rape the ground for short term profit. Economically and spiritually, I have a greater peace of mind knowing I am not spreading the "devil's brew" all over "God's creation".
Northeast		x	x		I use fewer farm inputs and obtain equal or nearly equal yields. There is no concern about family health problems because of accidental exposure to chemicals.
	x		x		Calcium will be my reason - need I mention more?
			x		There is no doubt that what we do and how we do it is right. It is rewarding in many ways. By the same token, "the hen does not dust herself in the dirt in front of the fox den."
		x	x		I have less input costs and my yields are competitive.
		x	x		I am concerned about what we eat. We grind our own wheat flour. By eating and living accordingly, we can be healthier people. If you are healthy, you feel good and face problems better.

	Are you a regenerative farmer in spite of short-term adverse repercussions to you and your family?		Are you and your family better off in the short-term, than if you farmed conventionally?		Explanation
	Yes	No	Yes	No	
West			x		I feel I am more in touch with the soil and treat it with more respect. When I used chemicals in the past, there was always some eye or skin irritation. I feel better about what we do.
		x	x		I feel my crops did not decline one bit when I quit using herbicides. I have also found an alternative crop that controls weeds in rotation and earns more per acre than summer fallow--wheat. My operation has actually become more profitable.
	x		x		Since I paid membership and am part of the Northern Plains Sustainable Agricultural Society, I feel secure both in practice and financially.