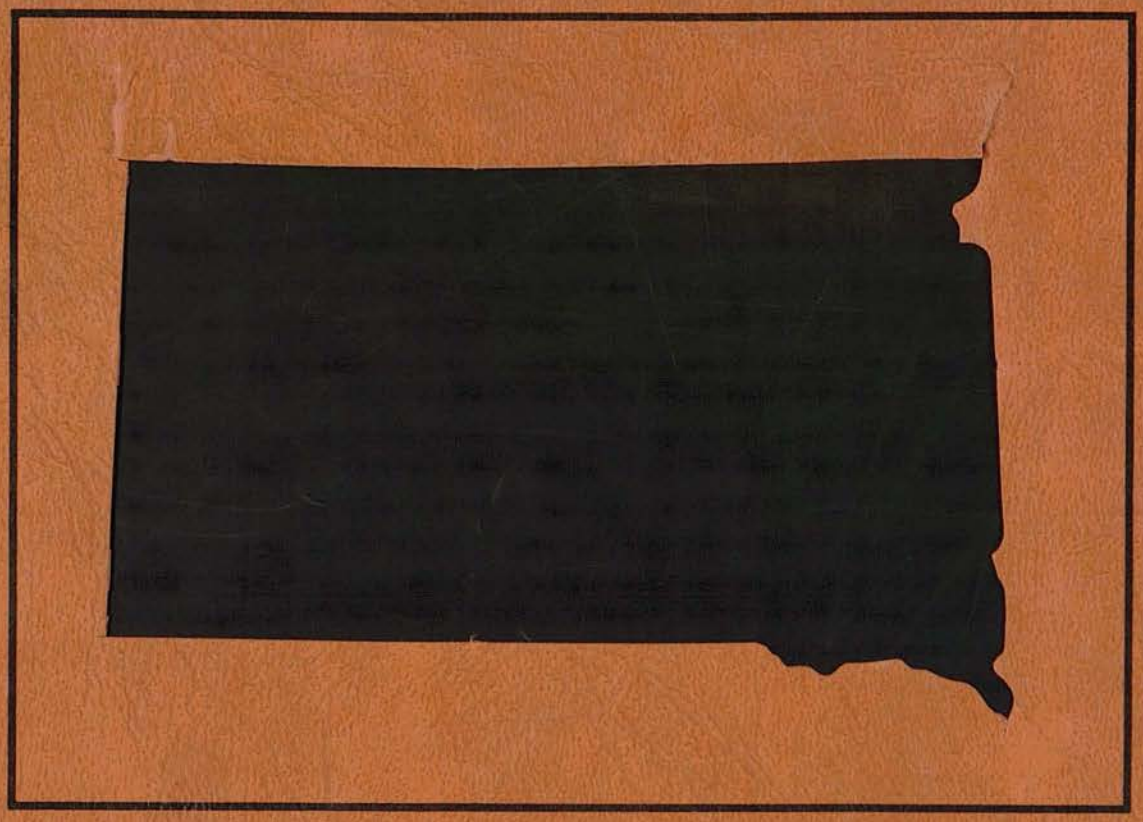

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SUSTAINABLE AGRICULTURE IN SOUTH DAKOTA

by

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SUSTAINABLE AGRICULTURE IN SOUTH DAKOTA

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

SUMMARY AND CONCLUSIONS

This is a report of the views and experiences of 32 South Dakotans who follow sustainable/regenerative agriculture practices on their farms. It is based on a mail survey undertaken during the summer of 1988. The research reported here complements that undertaken by South Dakota State University (SDSU) since 1984 on large experimental field plots at the University's Northeast Research Station near Watertown.

Twenty of the major findings concerning (a) the nature of South Dakota's regenerative farms and farmers, (b) their regenerative farm production and marketing practices, and (c) their evaluation of comparative yields, profits, and problems with regenerative versus conventional farming practices are summarized below.

1. Fifty seven percent of the surveyed South Dakota farmers consider crop **yields** to be generally higher with conventional than regenerative farming practices. Nevertheless, two-thirds of the respondents consider regenerative farming to be more **profitable** than conventional farming. Greater profits arise primarily because of lower out-of-pocket costs with regenerative practices. Higher market prices for some regeneratively raised commodities--as a result of selling in "organically certified" markets--and reduced production and price risks are additional economic benefits of regenerative farming. The risk reduction arises because of better moisture retention in the regeneratively farmed soil and greater enterprise diversification on the regenerative farms.

2. Fifty five percent of the respondents report using **zero levels** of all **synthetic chemical inputs**--fertilizers, pesticides, and livestock feed additives (antibiotics) and growth stimulants--on all their farm enterprises. The other 45% report using **moderate amounts** of one or more synthetic inputs on one or more of their farm enterprises. The most common moderately used synthetic chemical input consists of herbicides, with some regenerative farmers making limited use of banded and spot-sprayed applications to particularly weed-prone fields or portions of fields. About one-fourth of the respondents report using moderate quantities of synthetic chemical fertilizer.

3. **Crop rotations** constitute the single most important means that farmers use to control weeds, insects, and diseases on their regeneratively farmed cropland. Further, the legume forage and green manure cover crop components of crop rotations are considered the most important source of nitrogen and improved soil fertility for regeneratively-raised crops. Ninety five percent of the crop rotations reported by the respondents involve at least one small grain, 75% at least one row crop, and 63% at least one legume forage. Row crops are far more important in the southeast and northeast than in the central and western part of the state. A similar pattern applies to forage legumes, although regional contrasts are much less striking.

4. Seventy five percent of the respondents report using special **tillage and residue management** practices on their regeneratively farmed cropland. The clearest reflection of modified tillage practices is the reduced use or elimination of the moldboard plow in land preparation. In those instances where the moldboard plow is used, it is most commonly for incorporation of green manure crops and small grain stubble. Farmers consider special tillage and residue management practices as important means to control both soil erosion and weed growth.

5. Fifty six percent of the respondents report using special **grain drying and/or storage** practices. The principal thrust of these practices is to avoid artificial, expensive high-temperature drying of grains. Illustrative practices are crib drying of ear corn, planting early maturing grain varieties, somewhat delayed harvesting of crops, and natural bin aeration.

6. The surveyed regenerative farmers in South Dakota are typically **seasoned veterans** of regenerative agriculture. They have followed regenerative practices on their farms for an average of 14 years. About 70% of them have had between 5 and 19 years of experience with regenerative practices, and five have had 20 or more years of regenerative farming experience. The knowledge and insights on regenerative agriculture gained through these many years of experience represent an important resource to be tapped by University researchers and teachers and those involved in regenerative farming.

7. A strong flavor of "other-person" concern permeates the **motivations** of farmers to follow regenerative practices. Of the 10 possible suggested reasons for farming regeneratively, the four viewed as most important by the respondents are to (a) be a good steward of the soil; (b) reduce pollution of ground and surface water; (c) raise a residue-free, high quality product; and (d) reduce possible harmful effects of farm chemicals on the health of farmers and their families. Over time, the respondents have come to have increasingly strong reasons for following regenerative practices.

8. Sixty three percent of the respondents follow **regenerative practices** on **all** of their **cropland**. For the other respondents, the most common restrictions to 100% regenerative farming are limited management capacities and land-use restrictions on rented land.

9. The surveyed farmers follow **regenerative practices** on an average of five **enterprises** per farm. All farmers raise at least one grain and/or forage regeneratively, 78% at least one livestock enterprise regeneratively, and 19% at least one vegetable and/or specialty crop regeneratively. Over one-half of the respondents produce each of beef cattle, corn, alfalfa, wheat, and oats regeneratively. Soybeans and millet are the next most common regeneratively-produced commodities, followed by barley, rye, and hogs.

10. Sixty three percent of the respondents are **officially "certified organic"** producers. The most common reason for other farmers to not be officially "certified organic" is their continued use of moderate quantities of herbicides. A belief that there is no demand for "certified organic" products and a lack of information about procedures to become "certified organic" are additional reasons

for some sustainable farmers not being officially "certified organic."

11. Fifty nine percent of the South Dakota regenerative farmers report selling at least part of their regeneratively-raised produce through **"organic" market** outlets. The commodity most commonly sold through "organic" market outlets is millet, followed by wheat, soybeans, and corn.

12. The average **shares** of commodity produced regeneratively and **sold at a price premium** by respondents who receive the premiums are 100% for flax and between 92% and 76% for wheat, millet, sunflower, soybeans, and corn. [These findings pertain to only three to nine farmers per crop, however.] At the other extreme, two farmers who sell beef through "organic" market outlets are able to market only 2% and 15% of their total beef production for "organic"-based price premiums.

13. The **magnitudes** of "organically"-based **price premiums** (for product meeting pre-specified human consumption quality standards) vary considerably from farmer to farmer and by commodity. In general, however, the premiums appear to be highest for flax (on the basis of a cleaned and delivered weight), followed by sunflowers and millet. The lowest reported price premiums (most commonly 20-30%) are for soybeans and beef.

14. The most important **lessons learned about marketing** by the respondents are the following. While there is a growing "organic" market, a regenerative farmer has to work hard to access it. Establishing a solid reputation as a regular supplier of quality product helps a great deal. The most common problems in marketing involve (a) long distances from regenerative farms to grain processing plants and (b) the uncertain timing of purchases by wholesalers--which can present storage and cash-flow problems to individual producers. To help overcome these problems, some respondents suggest the development of market network systems and wholesalers assuming responsibility for storing "organic" products in relatively centralized and appropriately equipped warehouses.

15. Respondents collectively indicate **no continuing (persistent) problems** with regenerative agriculture to be **"very important."** The two problems viewed as "quite important" are (a) difficulties in finding organic market outlets and (b) a lack of up-to-date and accurate information on regenerative agriculture. Six problems are viewed as "somewhat important:" (a) ridicule from neighbors, (b) increased weed problems, (c) crop nitrogen shortages, (d) costly organic fertilizer and soil amendments, (e) increased management requirements, and (f) inadequate quantities of livestock manure and other organic waste products.

16. One striking feature of the responses to the possible-problems-with-regenerative-agriculture questions is the **wide range of views** among respondents on the relative importance of individual possible **problems**. At least four farmers (not always the same ones) gave each of the 15 possible problems a **0** ("totally unimportant") rating. At the other extreme, one or more farmers indicated a **5** ("very important") rating for all problems except three. This outcome reflects a certain degree of uniqueness among respondents in their respective production environments, managerial practices, and problem perceptions. Forums at which different regenerative farmers could share their individual experiences with and reactions to regenerative agriculture could shed

meaningful light on the particulars of these unique situations. Such forums could be instructive for the individual farmer participants and for others interested to learn more about regenerative agriculture.

17. It is commonly believed that certain problems will be accentuated when farmers initially convert from conventional to regenerative farming practices. The most critical **transition problem** reported by the South Dakota regenerative farmers is (a) increased weed problems, followed by (b) a lack of up-to-date and accurate information on regenerative agriculture, (c) ridicule from neighbors, (d) difficulties in finding organic market outlets, and (e) crop nitrogen shortages. While other researchers have not attempted to identify the existence of "transition problems" empirically through farmer surveys, the general literature on regenerative farming draws attention to increased weed problems and nitrogen shortages as problems during the period of converting from conventional to regenerative practices that are likely to be accentuated.

18. An unusually large proportion of the surveyed regenerative farmers are in the **"prime of their life."** Forty five percent of them are in the 35-44 age range, which is more than double the corresponding percentage for the state. Also, the average age of the regenerative farmers is somewhat less than that for farmers generally in the state.

19. A middle range of **farm sizes** appears to be somewhat more common for the surveyed regenerative farmers in South Dakota than for all farms in the state. Other studies of regenerative agriculture also show that regenerative practices are not precluded on significant numbers of relatively large-scale farms in the midwest, and that typically the regenerative practices may tend to be more compatible with medium- than very large-scale farming operations.

20. Forty two percent of the farmland operated by the surveyed regenerative farmers is **rented**--compared to 16% for the state as a whole. We hypothesize that one strategy of regenerative farmers to achieve long-term economic sustainability is to adopt somewhat conservative financial strategies for gaining access to larger land areas to operate.

INTRODUCTION

The purpose of this report is to describe what we have come to know of the nature of sustainable agriculture in South Dakota. It is based on the responses to a 1988 mail survey of 32 of the state's sustainable farmers. Emphasis is given to (1) the nature of the farms and the farmers who responded to the questionnaire, (2) their sustainable farm production and marketing practices, and (3) their evaluation of comparative yields, profits, and problems with sustainable versus conventional agriculture.[1]

In the context of this report, the term "sustainable" is comparable to the term "regenerative."[2] The latter term was used in the survey questionnaire. "Regenerative" was not rigidly defined in the questionnaire, however. As in some other farmer survey studies of sustainable/regenerative agriculture (e.g., Baker and Smith, 1987; Harris, **et al.**, 1980; Lockeretz and Madden, 1987), the questionnaire was used, in part, to determine how farmers view and actually practice sustainable/regenerative production techniques.

In the third major section of this report, the sustainable/regenerative practices followed by the survey respondents are described in some detail. This includes primary attention to farmer use (non-use) of synthetic chemical inputs, namely, fertilizers, pesticides, and livestock feed additives (antibiotics) and growth stimulants. Crop rotations and other special practices for controlling weeds, insects, and diseases are also covered.

The research covered in this report--that is focused on the farms of those in South Dakota who are following sustainable/regenerative practices in commercial farm production--complements SDSU's experiment station (large field plot) research on sustainable/regenerative agriculture undertaken at the University's Northeast Research Station near Watertown since 1984. Selected reports covering the results of that research are Dobbs, **et al.** (1987), Leddy, **et al.** (1988), Dobbs, **et al.** (1988), Dobbs and Mends (1989), and Smolik, **et al.** (1989).

MAIL SURVEY

The purpose of the mail survey was to gain a clearer view of the

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[1]When the term **"conventional"** is used in this report, reference is made to **non-sustainable/non-regenerative** farmers. Nothing is implied about whether "traditional" or "modern" non-sustainable/non-regenerative practices are followed.

[2]Other terms roughly equivalent to sustainable/regenerative are "low chemical input" and "alternative". The latter term has been largely used until now to describe SDSU's experiment station oriented research on sustainable/regenerative agriculture (e.g., Dobbs, **et al.**, 1988). "Organic" agriculture is a subset of the sustainable/regenerative category; farmers producing "organically" use **no** synthetic chemical fertilizers and pesticides.

different types of regenerative farming in South Dakota, the production and marketing practices of the state's regenerative farmers, and something of what these farmers have learned through their regenerative agriculture experiences. The survey questionnaire was sent to all farmers in the state who we had come to believe were **possibly** using greatly reduced or even zero levels of synthetic chemicals in their farming operations. Sources of information on such possible regenerative agriculture farmers were the Northern Plains Sustainable Agriculture Society[3], South Dakota area farm management and county extension agents, and other varied informants.

The initially prepared survey questionnaire was pre-tested in April-May 1988 with four farmer respondents. Revisions were then made and the questionnaire was finalized (a copy is included as Annex 1). The questionnaire was sent in early June to 93 farmers throughout the state. Those who had not responded by early July were sent follow-up letters and questionnaires. Those who had not responded as of late July and could be reached by telephone were so contacted.

Resulting from this process were 32 completed questionnaires. Twenty five of the initially contacted respondents informed us that they either were no longer farming at all or were no longer farming regeneratively. Twenty four informed us that they were farming regeneratively, but failed to return completed questionnaires. Attempts to contact 12 other non-respondents were unfruitful. Of those **known** to be regenerative farmers, the survey response rate was 57%.

The quantitative data from the survey were evaluated via the SAS-Micro Computer Stat Package (SAS Institute, Inc., 1988). Descriptive tables showing "means" (average values), "medians" (the observed values of variables for which the numbers of both larger and smaller values are the same), and ranges; frequency distributions; and simple two-way associative relationships (via ANOVA, Chi-Square, and NPAR1WAY "Median Score" analysis) were generated, analyzed, and interpreted.

The "Median Score" nonparametric statistical analysis was undertaken because some of the survey data were of an "ordinal" rather than "interval" nature. Illustrative ordinal data are farmer responses on **0 - 5** scales of degrees-of-importance of (1) possible problems with and (2) possible reasons for farming regeneratively. In such cases, the individual **0 - 5** category ratings for each individual respondent were clearly ordered, although the absolute distances among category ratings for different problems (reasons) for both individual and different respondents are unknown. Under these conditions, some statisticians (e.g., Agresti, 1984; Goodman, 1978; Siegel, 1956) express caution against using common (for economists) parametric statistical techniques.

Most of the study analysis was undertaken for the 32 respondents as a group. Because of important locational variations within the state in the

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[3]The address of the Northern Plains Sustainable Agriculture Society is c/o Dr. Fred Kirschenmann, Route 1, Box 73, Windsor, N.D. 58493.

physical and biological production environment, however, some more disaggregate analysis was also undertaken. The regional analysis was focused on clusters of 11 northeastern and 14 southeastern counties, as well as for 4 scattered counties in the central and western part of the state where the surveyed regenerative farmers are located (see Figure 1).

Resulting from our review of the literature was an identification of 20 reports of findings from 14 sustainable agriculture farmer-oriented surveys. An overview of the nature of these studies is provided in Annex 2. To aid in interpreting the findings from our survey, attention is drawn in the text to comparable findings concerning regenerative farmers from these other studies. As a further aid in interpreting the nature of the regenerative farms and farmers in our survey, attention is also drawn to comparable findings from the most recently available (for 1982) U.S. Census of Agriculture (USDC, 1984). Comparable average farm size data for 1987--based on SDASS (1988)--are also cited.

SUSTAINABLE FARMS AND FARMERS

As shown in Figure 1, 16 of the survey respondents are from southeastern South Dakota, 11 are from the northeast, and 5 are from the central and western part of the state. In some of the succeeding discussion, attention is directed toward differences in survey responses among these three "regions." Because the sample size is small, most contrasts in findings across regions can't be viewed as being definitive.

Farms

Nearly two-thirds of survey respondents have rather evenly balanced--in terms of annual gross farm sales--cash grain and livestock farms (Table 1). Although the others are more commonly specialized in cash grain than in livestock,[4] 88% of them raise livestock commercially. This incidence of livestock on South Dakota regenerative farms is roughly comparable with the 84% (Lockeretz and Madden, 1987), 90% (Lockeretz, **et al.**, 1981), 92% (Wernick and Lockeretz, 1977), and 100% (Klepper, **et al.**, 1977) reported for regenerative farmers in the states directly east and south of South Dakota. In contrast, only 42% of the fruit, vegetable, nut, and rice regenerative farmers studied in California reported animals to be an important part of their farming operations (Altieri, **et al.**, 1983).

Survey respondents report their most important farm enterprises as follows (Table 2):

- Most common, on one-third to one-half of the farms: beef cows, soybeans, corn, and wheat;

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[4]The most important difference regionally among respondents is an above-average number of cash grain farms and below-average number of cash grain-livestock farms in the northeast (Annex 3, Table 1).

- Intermediate, on one-tenth to one-fifth of the farms: oats, hog finishing, hog farrowing, cattle finishing, and millet; and

- Less common, on about one-fifteenth of the farms: fattening lambs, dairy, alfalfa, and rye.[5]

On the average, survey respondents operated 1,795 acres of farmland in 1988. However, one respondent, who just began to farm regeneratively in 1986 and who now has only 10% of his cropland under regenerative practices, operates as much land as all the others combined. Excluding that respondent, the average area operated per respondent is 885 acres. The average size of farm for all farmers in the state in 1982 is 1,271.[6]

Compared to all farmers in the state, a middle-range of farm sizes appears to be somewhat more common for the surveyed regenerative farmers. For example, 81% of the regenerative farmers operate farms with between 180 and 1,999 acres--compared to 63% for the state as a whole and 73% for farmers in the state with farm sales of $10,000 or more (Tables 3 and 4). Lockeretz, **et al.** (1981) report that regenerative practices are not precluded on significant numbers of relatively large-scale farms in the midwest. Harris, **et al.** (1980) and Youngberg and Buttel (1984) report that regenerative practices may tend to be more compatible with medium- than very large-scale farming operations.

Nearly 70% of the farmland operated in 1988 by the South Dakota survey respondents is cropland (Table 5). About 25% is in permanent pasture and rangeland.

Forty two percent (or 21%, if the "giant"-scale farmer is included) of the farmland operated by regenerative farmers is rented (Table 5).[7] This amount is considerably greater than the corresponding 16% for the state as a whole. Related to this, part- (in contrast with full-) ownership is more common for regenerative farmers than for all farmers in the state (Tables

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[5]As expected, beef cows and wheat are of above-average importance and corn and soybeans are below-average for the regenerative farmers in the central and western part of the state (Annex 3, Table 2). The major difference between the northeast and southeast regenerative farmers is a lesser prominence of wheat and a greater prominence of beef cow-calf operations in the southeast.

[6]Variations among regions in farm sizes are considerable, with mean operated acreages per farm as follows: southeast 580, northeast 685, and central and west 2,265 (Annex 3, Table 3). Compared to all farms in the respective regions, these regenerative farm size averages are 45% larger, 6% smaller, and 17% smaller. The disaggregate size-of-farm frequency distributions show, within each region, a somewhat smaller percentage of regenerative farms with 2000 or more acres than is true for all farms (Annex 4, Figures 1 and 2).

[7]Among regions in the state, the percentage of rented land for regenerative farmers in the selected central and western counties is somewhat greater than that in the southeast or northeast (Annex 3, Table 4).

6 and 7).[8]

Contrasts in land tenure patterns between regenerative and conventional farmers are covered in only one report that we reviewed. Harris, **et al.** (1980) report a higher percent of full ownership for regenerative (76%) than for conventional (56%) farmers in their Michigan study. Our findings contrast with theirs. We hypothesize that regenerative farmers may consciously try to achieve long-term economic sustainability through adopting more conservative financial strategies (e.g., renting rather than purchasing with highly leveraged arrangements) for gaining access to larger land areas to operate.

Farmers

The survey respondents range in age from 27 to 72 years and average 44 years. They are somewhat younger than farmers generally in the state, who in 1982 averaged 49 years of age.[9] Of perhaps greater interest is the strong concentration of regenerative agriculture farmers in the 35-44 age range (45% of them), which is more than double the corresponding percentage for the state (Table 8).

Our findings on the somewhat greater relative youth of regenerative farmers conform to those of Baker and Smith (1987) for regenerative farmers in New York and those of Harris, **et al.** (1980) for regenerative farmers in Michigan. They contrast, however, with the findings in several other studies which show the age of regenerative farmers in the midwest to be roughly comparable with that for conventional farmers (Lockeretz, **et al.**, 1981; Lockeretz and Madden, 1987; Lockeretz and Wernick, 1980). When results of the 1988 Census of Agriculture become available, we can more accurately compare (i.e., for the same time period) the surveyed regenerative farmers with the state's other farmers.

The surveyed regenerative farmers have operated their present farms for an average of 19 years, which is little different than the average of 20

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[8]This pattern is also strongly reflected in the data for the surveyed regenerative farmers in the (a) southeastern and (b) central and western parts of the state (Annex 4, Figures 3 and 4). For the northeast surveyed regenerative farmers, however, part ownership land tenure is less common than full ownership. Further, in the northeast, the proportions of part owner (a) regenerative farmers and (b) regeneratively farmed land are lower than the corresponding proportions for all farmers in the represented counties.

[9]Among regions in the state, regenerative farmers in the northeast tend to be older (mean age of 52 years) than those in the southeast (mean age of 38 years) (Annex 3, Table 5). The somewhat above-average age of the surveyed regenerative farmers in the northeast, compared to farmers in general from that region, is clearly reflected in the comparative frequency distributions of farmer ages shown in Annex 4, Figure 5. The relative youth of surveyed regenerative farmers from the southeast is also shown in that figure.

years for all farmers in the state.[10] Fewer of the regenerative farmers have been on their present farms for less than 10 years, however, than is true for all South Dakota farmers (21% versus 32%) (Table 9).[11] Baker and Smith (1987) report the New York regenerative farmers they studied to have had less farming experience than their conventional counterparts.

Nine (33%) of the 27 surveyed regenerative farmers who responded to a question on off-farm employment indicated that they have regular off-farm work.[12] This is slightly less than the 40% of all farmers in the state who have some off-farm work, but the same as the 33% of all farmers in the state **with sales of $10,000 or more** who have some off-farm work.

Our feeling has been that regenerative farming practices may be more labor-demanding, and therefore that regenerative farmers (in the Northern Plains, at least) may be less able to seek (less in need of) off-farm employment than their conventional counterparts. Some findings elsewhere in the U.S., however, show regenerative farmers disproportionately employed off-farm. For example, Baker and Smith (1987) report three-fourths of the regenerative farmers they surveyed in New York to have some type of off-farm job, compared to only about one-half for all New York farmers. Harris, **et al.** (1980) report 78% of the regenerative farmers they surveyed in Michigan to have household members with off-farm work, compared to 53% for conventional farmers.

SUSTAINABLE FARM PRODUCTION PRACTICES

Length of experience

The surveyed regenerative farmers in South Dakota have followed

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[10]Consistent with regional variations in the age of farm operators, the regenerative farmers from the northeast have operated their present farms for a longer period (a mean of 24 years) than those in the southeast (a mean of 15 years) (Annex 3, Table 6). Even in the southeast, however, a larger percentage of the surveyed regenerative farmers (93%) have operated their farms for five or more years than is true for all farmers in that region (84%) (Annex 4, Figure 6).

[11]This outcome could at least partially arise because of bias in the means that we used to obtain lists of possible regenerative farmers in South Dakota. Each list reflected farmers **known** to be possible regenerative farmers. Less experienced farmers could very well be under-represented in our study. This potential bias is inherent in all such studies in which target populations are not easily identifiable in advance.

[12]The South Dakota Census of Agriculture shows only slightly fewer farmers in the selected counties of central and western South Dakota to have some off-farm work (37%) than in the northeast (40%) and southeast (41%) (Annex 3, Table 7). Among the surveyed regenerative farmers, however, regional differences in off-farm work are great. None of the surveyed farmers in central and western South Dakota have regular off-farm work, but as many as 50% in the northeast do.

regenerative farm production practices for an average of 14 years. The median length of time is 12-13 years. The longest period for one of the 32 surveyed farmers is 42 years,[13] and the shortest is 1 year. About 70% of the surveyed farmers have had between 5 and 19 years of experience with regenerative practices, and five have had 20 or more years of regenerative farming experience (Table 10).

Except for one study, the length of experience for the South Dakota farmers is greater than that reported in other studies, as seen by the following:

- A mean of 9 years and a median of 6 years of regenerative farming experience for regenerative farmers in New York (Baker and Smith, 1987); and

- A mean of 6 years and a median of 7 years for two different groups of regenerative farmers in the midwest (Klepper, **et al.**, 1977; Lockeretz, **et al.**, 1980; Lockeretz and Wernick, 1980).

In the 1987 re-survey of midwestern regenerative farmers who had first been studied in 1977, the median year of beginning to farm regeneratively was again 1971--for a median length of experience with regenerative practices of 16 years (Lockeretz and Madden, 1987). To the extent that regenerative farming practices have "staying power", however, more recently conducted studies--such as the ones by (a) Lockeretz and Madden, (b) Baker and Smith, and (c) ours--should show greater reported lengths of regenerative farming experience.

One-half of the South Dakota survey respondents switched to regenerative farming after starting to operate their present farm (Table 11). Ten percent of them started to farm regeneratively when they started to operate their present farm, and the other 40% were farming regeneratively before they started to operate their present farm.

Analogous findings in the literature are of a slightly different nature. Instead of the reference point in following regenerative practices being the year the farmer began to operate his present farm, the reference point was simply whether the regenerative farmer had farmed conventionally before taking up regenerative farming. The proportions of farmers in different studies having first farmed conventionally are:

- "Nearly 75%" for midwestern farmers (Blobaum, 1984);

- 84% for midwestern farmers (Lockeretz and Madden, 1987);

- 87% for midwestern farmers (Lockeretz and Wernick, 1980);

- A "minority" for New York farmers (Baker and Smith, 1987); and

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[13]One respondent reports that he is a fourth-generation regenerative farmer.

- Slightly over one-half for Michigan farmers (Harris, et al., 1980).

Reasons for farming regeneratively

The surveyed regenerative farmers were asked to rate the relative importance of 10 suggested possible reasons for their farming regeneratively--both at the time when they first decided to farm regeneratively and now (the latter, only if they had farmed regeneratively for at least 2 or 3 years). They registered their ratings on a scale of **0** to **5**, where **0** meant not at all important and **5** meant very important. Responses for both time frames are first presented and discussed collectively, followed by contrasts between the 2 time frames.

The mean and median scores, based on the responses of the individual surveyed farmers to each of the 10 possible reasons and for both time frames, are relatively "high"--equaling or exceeding **2.5** with only one exception (Table 12). Within the 10 possible reasons, the following four were rated as most important:

- To be a good steward of the soil;

- To reduce pollution of ground and surface water;

- To raise a residue-free, high quality product; and

- To reduce possible harmful effects of farm chemicals on the health of farmers and their families.

The other six possible reasons that respondents farm regeneratively are listed in rough order of importance in Table 12.

Two other research teams report why midwestern regenerative farmers choose to farm regeneratively. Lockeretz and Madden (1987) indicate that regenerative producers believe that regenerative practices are healthier for farmers and their families, healthier for livestock, "better" for the environment, and "better" for the soil. Wernick and Lockeretz (1977) indicate beliefs that regenerative practices are healthier for farmers and their families and healthier for livestock.

The South Dakota surveyed regenerative farmers report increasingly strong reasons over time for following regenerative practices. The mean degree of importance of each possible reason to farm regeneratively is greater now than when regenerative farming was first begun. Any differences in medians or range values are also in the same direction.[14]

Nineteen (63%) of the 30 surveyed regenerative farmers who indicated

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[14]We do not know, however, the extent to which South Dakota farmers who formerly followed regenerative practices no longer do. Presumably, their reasons for following regenerative practices have weakened with the passage of time.

whether all or only part of their cropland is now farmed regeneratively report 100% regenerative cropping. Wernick and Lockeretz (1977) report 83% of the midwestern regenerative farmers in their survey to farm all their cropland regeneratively.

Of the 19 South Dakota farmers who now follow regenerative practices on all their cropland, 16 provided information on the length of time that it took to "completely convert" from conventional to regenerative practices on their farms. The mean length of time is 3.3 years, with the numbers of years for different farmers ranging from 1 to 10. Seven of the farmers (44%) required 2 years or less and four (25%) required 4 years or more (Table 13). By comparison, Wernick and Lockeretz (1977) report that "most" of the regenerative farmers they studied converted all their land by the first or second year.[15]

Of the 11 surveyed regenerative farmers who indicate only part of their cropland being farmed regeneratively in 1988, five report between 60% and 90% of their cropland under regenerative practices and six report between 10% and 50% under regenerative practices. The most common restrictions to 100% regenerative cropping are limited management capacities and land-use restrictions on rented land (Table 14). Tenancy problems are also cited as restrictions to 100% regenerative cropping for farmers in the Blobaum (1984) and Wernick and Lockeretz (1977) studies.

To understand more fully why some farmers follow regenerative practices on all their cropland and others do not, some simple two-way associative relationships were examined for the individual respondents between (a) the percentage of cropland farmed regeneratively and (b) certain farming practices and experiences (Table 15) and certain general farm and cropland variables (Table 16). The different variables and the statistical procedures used in testing possible associative relationships are described in some detail in the two tables.

Of the 11 variables examined, only two proved to be significantly related to the percentage of cropland farmed regeneratively. The two variables involve two tested measures of a respondent's perceived overall intensity of problems with regenerative agriculture--one a "means" test (ANOVA) and the other a "median" test (NPAR1WAY Median Score). The results show that farmers who perceive the overall intensity of problems with regenerative agriculture to be less tend to follow regenerative practices on a larger percentage of their cropland.

Farm commodities produced regeneratively

All 32 surveyed South Dakota farmers raise regeneratively at least one grain and/or forage, 25 (78%) at least one livestock enterprise, and six (19%) at least one vegetable and/or specialty crop. An average of five farm

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[15]Dabbart and Madden (1986) indicate that "the length of the biological transition phase varies depending on field conditions, often ranging from 3 to 6 years".

commodities per respondent are produced regeneratively. No one raises only a single commodity regeneratively.

Over one-half of the survey respondents report using regenerative practices in the production of beef cattle, corn, alfalfa, wheat, and oats (Table 17). Soybeans and millet are the next most common regeneratively produced commodities, followed by barley, rye, and hogs. Analogous findings in the literature are as follows:

- Lockeretz, **et al.** (1981) report the most common regeneratively produced commodities by midwest regenerative farmers, in descending order, to be corn, hay, soybeans, oats, and wheat--which is very similar to our findings, except for the omission of beef cattle in their listing; and

- Baker and Smith (1987) report only 3% of their surveyed regenerative farms in New York to produce only one commodity regeneratively and most to produce at least five regeneratively--which also generally parallels our findings.

Synthetic chemical input practices

Seventeen (55%) of the 31 South Dakota survey respondents answering a question on **synthetic chemical input use** report using **zero levels** of all synthetic chemical inputs--fertilizers, pesticides, and livestock feed additives (antibiotics) and growth stimulants--on all their farm enterprises. The other 45% report using **moderate amounts** of one or more synthetic inputs on one or more of their farm enterprises.[16]

The most common moderately used synthetic chemical input consists of herbicides (36% of the respondents) (Table 18), with some regenerative farmers making limited use of banded and spot-sprayed applications to particularly weed-prone fields or portions of fields. About one-fourth of the respondents report using moderate quantities of synthetic chemical fertilizer, and between 10% and 15% use moderate quantities of livestock feed additives and growth stimulants.[17]

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[16]In some instances, the "moderate amounts" apply to cropland on a respondent's farm that is not farmed regeneratively. For such farmers, "zero levels" may apply to the cropland that is farmed regeneratively.

[17]One farmer reports using "probiotics" to help promote rumen activity and effective feed utilization by his dairy cows. He also uses "probiotics" with his young stock during times of "stress, cold, wet, weaning, etc." In follow-up personal interviews with 23 of the mail survey respondents, we are examining more broadly the producers' regenerative livestock practices. This includes attention to the extent to which feed inputs are regeneratively- raised, the "capital intensity" of livestock feeding and handling facilities, and specific ways in which livestock and crop enterprises complement each other.

Studies with at least somewhat similar types of findings are the following:[18]

- Lockeretz and Madden (1987) report 28% of their surveyed midwestern regenerative farmers in 1987 to "occasionally use" herbicides, 22% super phosphate, and 18% urea;

- Baker and Smith (1987) report "about one in six" of their surveyed regenerative farmers in New York to use some form of N-P-K fertilizers on some or all of their cropland; and

- Klepper, **et al.** (1977) report only 1 of their 14 regenerative Corn Belt farmers to use herbicides and none of them to use insecticides.

The South Dakota surveyed regenerative farmers view legume crops as their overall most important source of nitrogen for regenerative crop production, followed by crop residues and non-composted livestock manure (Table 19). Purchased "organic" soil amendments and commercial "organic" fertilizers and organic waste products other than livestock manure, on the other hand, are generally reported to be relatively unimportant sources of nitrogen in regenerative production.

The most important departures from this general pattern for individual crops are the following (Table 20):

- Non-composted livestock manure represents a less important source of nitrogen for wheat than for other crops;

- A prior soybean crop in rotation represents a more important source of nitrogen for corn than for any other crop;

- Purchased "organic" soil amendments represent a more important source of nitrogen for alfalfa than for other crops; and

- Purchased commercial "organic" fertilizers represent a more important source of nitrogen for oats than for other crops.

Analogous findings on non-synthetic chemical nutrient sources in the literature are as follows:

- Lockeretz, **et al.** (1981) report midwestern regenerative farmers to "use legume forages as the primary source of sustained soil fertility (along with small amounts of on-farm manure, purchased rock phosphate, and proprietary organic soil amendments of low nitrogen, phosphorus, and potassium content);"

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[18]Because "regenerative" farming was defined to represent the total absence of synthetic chemical use in some of the farmer-oriented surveys, and it was not in our study, there are important limitations in comparing our findings on the real-world "purity" of regenerative practices with that shown in other studies.

- Lockeretz and Madden (1987) report 84% of surveyed midwestern regenerative farmers to use commercial organic soil amendments or fertilizers in 1977 and 59% in 1987;

- Baker and Smith (1987) report "spreading manure, growing cover crops, and rotating crops" by 75% or more of their surveyed regenerative farmers in New York;

- Altieri, **et al.** (1983) report 75% of their surveyed regenerative farmers in California to "use cover crops in orchards and/or winter legumes for green manure;" and

- Vail and Rozyne (1982) indicate the following percentages of surveyed regenerative farmers in Maine to report as their principal sources of soil nitrogen: off-farm manure 71%, on-farm manure 42%, "soluble chemicals" 29%, and green manure 0%.

Other regenerative practices

In addition to limiting synthetic chemical input use, all of the South Dakota surveyed regenerative farmers consider the use of **crop rotations** as a main regenerative farming practice (Table 21).[19] They report crop rotations to constitute their single most important means for controlling each of weeds, insects, and diseases on their regeneratively farmed cropland. The legume forage and green manure cover crop components of crop rotations are also considered the most important source of nitrogen and improved soil fertility of regeneratively raised crops.

Ninety five percent of the crop rotations reported by the respondents involve at least one small grain, 75% at least one row crop, and 63% at least one legume forage (Table 22).[20] Row crops are far more important in the southeast and northeast than in the central and western part of the state. A similar pattern applies to forage legumes, although regional contrasts are much less striking.

Each of the nine reported crop rotations in the selected central and western counties in the state involves both at least one small grain and summer fallowing. The fallowing intensities in this part of the state range from once per 2 years to once per 5 years. Fallowing intensities in the northeast are similar to these, although a few farmers fallow less frequently than once in 5 years. One farmer in the northeast and one in the southeast allow their land to "rest" every seventh year.

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[19]Baker and Smith (1987) found 73% of their surveyed New York organic farmers to use crop rotations.

[20]See Annex 5 for a complete listing of the 40 crop rotations reported by the survey respondents and a listing of farmer insights on the roles of crop rotations in regenerative agriculture.

All the South Dakota survey respondents also report using special regenerative **weed control** practices (Table 21). After crop rotations, their most important means of weed control are using only certified and/or "clean" seed, adjusting crop planting dates, selecting weed competitive crops, and cultivating and harrowing more frequently (Table 23). At the other extreme, of the 13 suggested possible weed control practices, the 2 of least importance are intercropping and biological control.

Lockeretz **et al.** (1981) report midwestern regenerative farmers to use more mechanical cultivation of row crops (corn and soybeans) than conventional farmers in controlling weeds. The dominant forms of weed control reported by Baker and Smith (1987) are tractor cultivation, hand weeding, and hand tool cultivation--followed by crop rotations and weed suppressing cover crops. Altieri, **et al.** (1983) report mechanical discing and/or mowing to be the most common methods for controlling weeds in dry farmed orchards and vineyards in California.

Twenty nine (91%) of the 32 surveyed South Dakota regenerative farmers report following special insect and disease control practices (Table 21). Their most important insect and disease control measures--considerably after crop rotations--are adjusted crop planting dates, cover crops, modified tillage practices, and selecting pest resistant varieties (Table 24).

Analogous findings from other studies are as follows:

- Lockeretz, **et al.** (1981) found midwestern regenerative farmers to mainly use crop rotations, not "exotic" biological control techniques, to combat major pests;

- Baker and Smith (1987) report that about 50% or more of their surveyed regenerative farmers in New York select relatively insect-free crops, use plant-derived (e.g., rotenone) and "pathogen" (e.g., **Bacillus thuringiensis**) insecticides, and follow crop rotations to control insects; and

- Altieri, **et al.** (1983) report the use of bell beans as a cover crop, reducing from 45% to 22% the yield losses arising from codling moths in California apple orchards.

Twenty four (75%) of the 32 surveyed South Dakota regenerative farmers report using special **tillage and residue management practices**. The clearest reflection of modified tillage practices is the reduced use or elimination of the moldboard plow in land preparation (Table 25). In those instances where the moldboard plow is used, it is most commonly for incorporation of green manure crops and small grain stubble. Farmers consider special tillage and residue management practices as important means to control both soil erosion and weed growth. The specific tillage and residue management practices followed by individual survey respondents are listed in Annex 6.

Attention to special tillage and residue management practices is indicated in only one farmer survey report that we reviewed. Lockeretz, **et al.** (1978) report that "most organic farmers use a chisel plow or disc, which buries less residue than the moldboard (plow) and, therefore results

in less soil erosion." In their study of 14 matched pairs of regenerative and conventional Corn Belt farmers, for example, only 1 of 10 regenerative farmers who raised soybeans after corn and none of the 11 regenerative farmers who raised corn after soybeans used a moldboard plow. For conventional producers, 6 of 11 farmers moldboard-plowed their corn ground and 3 of 11 did so to their soybean ground.

Eighteen (56%) of the surveyed South Dakota regenerative farmers report using special **grain drying** and/or **storage** practices. The principal thrust of these practices is to avoid artificial, expensive high-temperature drying of grains. Illustrative practices are crib drying of ear corn, planting early maturing grain varieties, somewhat delayed harvesting of crops, and natural bin aeration. See Annex 7 for a detailed listing of the special grain storage and/or drying practices and Annex 8 for other regenerative farming practices reported by the respondents.

SUSTAINABLE AGRICULTURAL MARKETING PRACTICES

Organic certification

Twenty (63%) of the 32 surveyed South Dakota regenerative farmers are officially "certified organic" producers. Three of them are certified through two programs, 16 are certified through one program, and 1 provided no information on the program(s) through which he is certified.

The most common reported reason for the other 12 regenerative farmers to not be officially "certified organic" producers is their continued use of moderate quantities of herbicides (and for one farmer, synthetic chemical fertilizers, as well) (see Annex 9). A belief that there is no demand for "certified organic" products and a lack of information about procedures to become "certified organic" are additional reasons for some regenerative farmers not being officially "certified organic."

In only one report of surveyed organic farmers did we find information on the "certified organic" status of producers. In that report, Altieri, **et al.** (1983) indicate that 66% of the surveyed California regenerative farmers belong to a formal growers organization.

Selling through "organic" market outlets

Nineteen (59%) of the South Dakota regenerative farmers report selling at least part of their regeneratively-raised produce through "organic" market outlets. Those who do not, of course, are most commonly the farmers who are not officially "certified organic" producers. Two producers who are officially "certified organic," however, do not sell any produce through "organic" market channels (one to avoid verification costs and the other because of not finding an "organic" market yet). On the other hand, one regenerative farmer who is not "certified organic" (because he spot-sprays herbicides) does sell his corn at a price premium to a hog producer.

The commodity most commonly sold through "organic" market outlets is

millet; one-half of the 18 respondents answering this question report the "organic" marketing of millet (Table 26). The commodities next most commonly sold through "organic" market outlets are wheat, soybeans, and corn. At the other extreme, only one farmer reports selling each of alfalfa seed, buckwheat, dry beans, and oats through "organic" markets and only two farmers (11% of the 18 farmers) sell rye and beef through "organic" markets.

Analogous findings from the literature are as follows:

- Wernick and Lockeretz (1977) report that 27% of their surveyed midwestern regenerative farmers marketed some of their livestock through "organic" channels;

- Lockeretz and Madden (1987) report 39% in 1977 and 42% in 1987 of their surveyed midwestern regenerative farmers to be using special markets for some of their regeneratively-produced crops and livestock; and

- Blobaum (1984) reports one-half of his surveyed midwestern regenerative farmers to have sold, or to be planning to sell, at least some of their production through special "organic" marketing channels, with the commodities including livestock and poultry fed regeneratively-grown grain, wheat, soybeans, other grains and beans, vegetables, eggs, and fruit.

Eighteen of the South Dakota regenerative farmers provided information on the type of "organic" market outlet to which they sell their regeneratively-raised products. Five (28%) of the 18 report using two different outlets; 13 (72%) report using one outlet only. The types of outlets used are as follows:

- 18 (100%) of the farmers sell to wholesale buyers;
- 3 (17%) sell direct to consumers (two involve beef);
- 1 (6%) sells directly to an "organic food" outlet (wheat); and
- 1 (6%) sells corn directly to a hog feeder.

Foster and Miley (1983) report 66% of their Kansas organic farmers to select local cooperatives and community farmers' markets as the outlets for their "organically"-raised produce. Altieri, et al. (1983) report California regenerative farmers to sell their produce direct from the farm; from private roadside stands; directly to communities via weekly truck routes; directly or through regional brokers to health food stores, local grocery stores, food cooperatives, restaurants, and "organic" commodity distributors; and through farmers' markets.

The 19 South Dakota regenerative farmers who sell at least part of their regeneratively-raised commodities through "organic" market outlets all report receiving "organic"-based price premiums. These farmers were asked to indicate (1) the shares of each commodity they produce regeneratively for which a price premium is received and (2) the approximate magnitude of the price premiums received.

All four farmers who sell flax for a price premium sell 100% of their production at a price premium (Table 27). Farmers who sell wheat, millet,

sunflowers, soybeans, and corn at a price premium report selling an average of between 92% and 76% of their regenerative production at a price premium. At the other extreme, two farmers who sell beef through "organic" market outlets are able to market only 2% and 15% of their total beef production for "organic"-based price premiums.

Farmers who report selling part, but not all, of their regeneratively-raised produce at a price premium most commonly indicate a perceived lack of demand for their organic products as the underlying reason (see Annex 10). Two of the respondents cite cash-flow problems which arise when the opportunity to sell their regeneratively-raised produce is delayed.

The only somewhat similar findings in the literature on shares of regeneratively-raised produce sold through special "organic" market outlets of which we are aware is that by Lockeretz and Madden (1987) for midwestern regenerative farmers. They report 11% in 1977 and 22% in 1987 of the respective surveyed regenerative producers to make at least one-half of their regenerative crop sales through special markets. The corresponding percentage for regenerative livestock sales is 13% for both 1977 and 1987. Although these findings are not directly analogous to ours, there are tentative indications that relatively larger percentages of regeneratively produced crops may be sold for "organic"-based price premiums in South Dakota than in the states south and east of South Dakota.[21]

The magnitudes of "organically"-based price premiums reported by the South Dakota regenerative producers vary considerably from farmer to farmer and by commodity (Table 28).[22] In general, however, the premiums appear to be highest for flax (commonly double or more) and next greatest for sunflowers and millet. The lowest reported price premiums (most commonly 20-30%) are for soybeans and beef. These price premiums tend to be higher than those few that are reported elsewhere in the literature:

- Blobaum's (1984) study of midwestern regenerative farmers showed "organically"-based price premiums "as high as" 70% on oats, 30% on wheat, 25% on soybeans, 20% on corn, and 10% on beef; and

- Berardi's (1978) study of New York regenerative farmers showed a

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[21]As noted above, the main source of names of possible regenerative farmers for our survey study was the Northern Plains Sustainable Agriculture Society (NPSAS). We expect there may be some relationship between NPSAS membership and the "organic" marketing of regeneratively-raised produce. The extent to which such possible bias in "organic" market involvement may may derive from the sample selection procedures in others studies is unknown.

[22]In interpreting these price premiums, one must recognize that the price premium is most commonly based on the weight of a clean and delivered product meeting human consumption standards. Terms involving 30-90 days until payment rather than immediate cash are also commonly involved with "organically" market grain.

$0.04/kg (20-25%) price premium for "organically"-produced wheat.

Of the South Dakota regenerative farmers who projected the direction over the next 2 to 3 years of "organically"-based price premiums, 50% indicated the premiums would probably remain the same, 40% projected price increases, 10% were unsure, and no one expected the price premium to decrease. Those who expect the price premiums to increase most commonly cite a growing demand for "organic" foods in Europe and the U.S. and a belief that increasing numbers of Americans are becoming more health-conscious.

Of the 19 respondents who sell at least part of their regeneratively-raised produce through regenerative markets, 15 (83%) market their products as individual sellers, three (17%) market their products collectively (e.g., one through the NFO, one with a brother), and one provided no information.

Respondents were asked to describe what they have learned about opportunities for and limitations to the effective marketing of regeneratively-raised products (see Annex 11). Several indicated that there is a growing "organic" market, but one has to work hard to access the market. Establishing a solid reputation as a regular supplier of quality product helps a great deal. The most common problems in marketing involve long distances from producers' farms to grain processing plants and the uncertain timing of purchases by wholesalers--which can present storage and cash-flow problems to individual producers. To help overcome these problems, two respondents raised the possibility of developing marketing network systems and of wholesalers assuming responsibility for storing "organic" products in more centralized and appropriately equipped warehouses.

EVALUATION OF SUSTAINABLE AGRICULTURE

Crop yields

Fifty seven percent of the South Dakota surveyed farmers consider crop yields to be generally higher with conventional than regenerative farming practices (Table 29).[23] Of the remainder, about equal numbers (1) consider

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[23]To understand the possible relationship between farmers following particular regenerative farming practices and holding particular beliefs concerning relative crop yields with regenerative versus conventional farming practices, some simple two-way associative relationships--similar to those explained above on possible factors associated with the percentages of producers' cropland acreages farmed regeneratively--were examined. The results of this analysis showed:

- A significant (0.01 level) association between farmers using no fertilizer at all and believing that yields are not necessarily higher with conventional practices;

conventional and regenerative yields to be about the same, (2) consider regenerative yields to be generally higher, and (3) are unsure about yield differences. Several of those who consider crop yields now to be generally higher with conventional practices believe that, over time, regenerative yields will grow to become equal to or to exceed conventional yields. The building of soil that results from regenerative practices takes time, but as the soil does build up, they feel that prospective yields will almost inevitably increase.

The six regenerative farmer-oriented survey reports showing comparative yields for conventional and regenerative fields that we reviewed reveal a definite tendency for conventional yields to be higher than regenerative yields (see Annex 12). The margin of yield difference is most commonly in the range of 1% to 10%. In a few cases, the margin of difference is greater. This outcome is most common in years of unusually favorable weather and other production conditions. In some cases, however, regenerative yields are higher than conventional yields. This outcome occurs most commonly in years with unfavorable production conditions.

Profits

Two-thirds of the South Dakota surveyed farmers consider regenerative farming to be more **profitable** than conventional farming (Table 30). Only 2 of the 32 farmers consider profits to be generally less with sustainable practices.[24] Most respondents cite considerably lower out-of-pocket costs of production as the primary reason for greater profits with regenerative agriculture. Higher market prices for some regeneratively-raised

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- A significant (0.05 level) association between farmers following all five special crop rotation, tillage and residue management, weed-control, insect and disease control, and drying/storage regenerative practices and believing that yields are higher with conventional practices; and

- No significant (0.10 level) association between (a) beliefs that conventional yields are higher than regenerative yields and (b) either farmers using no synthetic chemicals at all or farmers following just the first four of the five special regenerative practices listed above.

[24]To understand the possible relationship between (a) particular beliefs concerning the relative profitability of regenerative and conventional farming practices and (b) particular farmer characteristics and regenerative farming practices, some simple two-way associative relationships were examined. The results of analysis showed no statistically significant (0.10 level) association between individual farmer views on relative profits with regenerative versus conventional practices and each of the following variables: (a) number of years with regenerative farming experience, (b) type of farm, (c) whether a "certified organic" producer, (d) whether the farmer sells some produce through "organic" market outlets, (e) whether a producer uses no synthetic chemical fertilizer, (e) whether a producer uses no synthetic chemicals at all, and (f) whether a producer follows special crop rotation, residue management, weed control, insect control, and drying/storage regenerative practices.

commodities--as a result of selling in "organic" markets--and reduced production and price risks are reported to be additonal economic benefits from following regenerative farming methods. The risk reduction arises because of better moisture retention in the regeneratively farmed soil and greater enterprise diversification on the regenerative farms.

The careful empirical measurement of farming profits involves a multitude of details and assumptions. Therefore, drawing meaningful conclusions from comparative reports of profits for different studies is somewhat problematic. Nevertheless, the review of the five reports that we found dealing with regenerative-conventional farming profits shows the following general conclusions (see Annex 13). In a majority of the studies, the profits from farming regeneratively are reported to be roughly comparable with those from farming conventionally. Profits are sometimes reported to be higher with conventional practices, however, especially in years of unusually favorable production conditions. The pattern for relative improvement in regenerative compared to conventional yields when weather conditions are unfavorable also shows itself in regard to profits.

One analytic complication in interpreting studies of comparative farm profitability concerns the unit of analysis. The comparative analysis may be done at the level of individual enterprises or on a whole-farm basis. The latter, of course, takes into account not only individual enterprise profitabilities but also the proportional allocation of given land areas to the individual crops comprising particular rotations. A low-value crop in a regenerative rotation, for example, can sometimes more than offset several other enterprises that otherwise would provide more favorable returns with regenerative practices. For most purposes, comparative profits from whole-farm analyses are more meaningful than comparative profits for individual crop enterprises.

Farm labor requirements

Of the 31 South Dakota regenerative farmers answering a question on whether following regenerative rather than conventional farming practices adds to farm labor requirements, 23 (74%) said yes, 5 (16%) said no, and 3 (10%) said they were unsure. Those who responded yes indicated that the most important source of increased labor requirements is more time in weed control, including mechanical cultivation (Table 31). A second level of importance for added labor being required with regenerative practices arises from (1) the added diversity of crop enterprises requiring attention and (2) more time in seeking out "organic" market outlets. The added time in crop insect and disease control with regenerative practices is considered to be relatively limited.

Somewhat analogous findings are reported from three other studies of regenerative agriculture (see Annex 14). Two of the studies show greater labor requirements per unit of land with regenerative practices. The third shows less hired labor on regenerative farms.

Problems

The South Dakota regenerative farmers were asked to rate the relative importance of 15 suggested **possible problems** (difficulties) with regenerative agriculture on the same **0** to **5** scale as used in several previous places in this study. Two types of problem ratings were requested--one concerning persistent or **continuing** problems over time and the other concerning problems at the time of **transition** in converting from conventional to regenerative practices. Transition problems were described to respondents as exaggerated forms of what later came to be continuing problems, or as problems that arose during the transition period but eventually disappeared "by the end of the transition period." The farmers' responses are summarized in Table 32.[25] Attention is first given to continuing problems, and then to transition problems.

The mean and median scores for no one continuing problem exceed **3**, thus indicating that no persisting problems are, for the respondents collectively, "very important." The varying intensities of continuing problems lend themselves to a three-part characterization.

- **Quite important.** The two problems receiving the highest ratings are (1) difficulties in finding "organic" market outlets and (2) lack of up-to-date and accurate information on regenerative agriculture. In the five other farmer survey studies of regenerative agriculture in which problems/disadvantages of regenerative agriculture are reported (see Annex 16), four draw attention to marketing problems and three to inadequate information.

- **Somewhat important.** Six problems fit this category for the South Dakota regenerative farmers: (1) ridicule from neighbors, (2) increased weed problems, (3)crop nitrogen shortages, (4) costly organic fertilizer and soil amendments, (5) increased management requirements, and (6) inadequate organic waste product supplies. In all five of the other farmer surveys with analogous reported information, attention is drawn to increased weed problems (see Annex 16). Two of the other reports affirm the importance of ridicule from neighbors and one an added management requirement with regenerative farming.

- **Relatively unimportant.** The other seven possible problems indicated in Table 32 received the lowest ratings collectively by the respondents. Within these seven, the first four can probably be viewed as somewhat more important than the last three.

One striking feature of the responses to the possible-problems-with-regenerative-agriculture question is the wide range of views among respondents on the relative importance of individual possible continuing problems. For each possible problem, at least four farmers (not necessarily

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[25]See Annex 15 for a listing of the specific problems reported by individual survey respondents with regenerative agriculture and approaches for dealing with the problems.

the same ones) gave it a **0** ("totally unimportant") rating. At the other extreme, one or more farmers indicated a **5** ("very important") rating for each possible problem except three.[26] This outcome reflects a certain degree of uniqueness among respondents in their respective production environments, managerial practices, and problem perceptions. Forums at which different regenerative farmers could share their individual experiences with and reactions to regenerative agriculture could shed meaningful light on the particulars of these unique situations. Such forums could be instructive for the individual farmer participants and for others interested in learning more about regenerative agriculture.

The most important transition problem reported by the South Dakota regenerative farmers is (1) increased weed problems, followed by (2) a lack of up-to-date and accurate information on regenerative agriculture, (3) ridicule from neighbors, (4) difficulties in finding "organic" market outlets, and (5) crop nitrogen shortages. The degree of problem importance during the transition from conventional to regenerative practices--as reflected by mean and median values--is greater than the continuing degree of importance for nearly all problems. The degree of difference is most exaggerated for increased weed problems, with the mean transition versus conventional problem ratings being **3.30** and **2.07**, respectively.

To our knowledge, other researchers have not attempted to identify transition problems empirically through a farmer survey approach such as ours. The general literature on regenerative farming, however, does draw attention to increased weed problems and nitrogen shortages (e.g., Culik, 1983; Cacek and Langner, 1986) as problems whose importance during the period of converting from conventional to regenerative practices is likely to be accentuated.[27]

Plans for the future

All 32 of the South Dakota survey respondents plan to continue to follow regenerative farming practices. In answer to an open-ended question on why they planned to (or not to) continue, respondents commonly referred to some of the reasons why they currently farm regeneratively (as reported in Table 12). Because these open-ended responses may be particularly effective in capturing the motivations of the respondents to farm regeneratively, we have reported the individual responses in Annex 18. We are impressed with the strong flavor of "other-person" concern in the motivations of farmers to follow regenerative practices, and also with the fact that many farmers are finding regenerative practices to be in their own best economic interests, as well.

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[26]See Annex 17 for a frequency distribution portrayal of sustainable farmer responses to possible continuing and transition problems with regenerative farming practices.

[27]See also Dabbert and Madden (1986) for a simulation modeling of the transition to organic agriculture.

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Figure 1. Location of 1988 South Dakota regenerative agriculture survey respondents, by region.

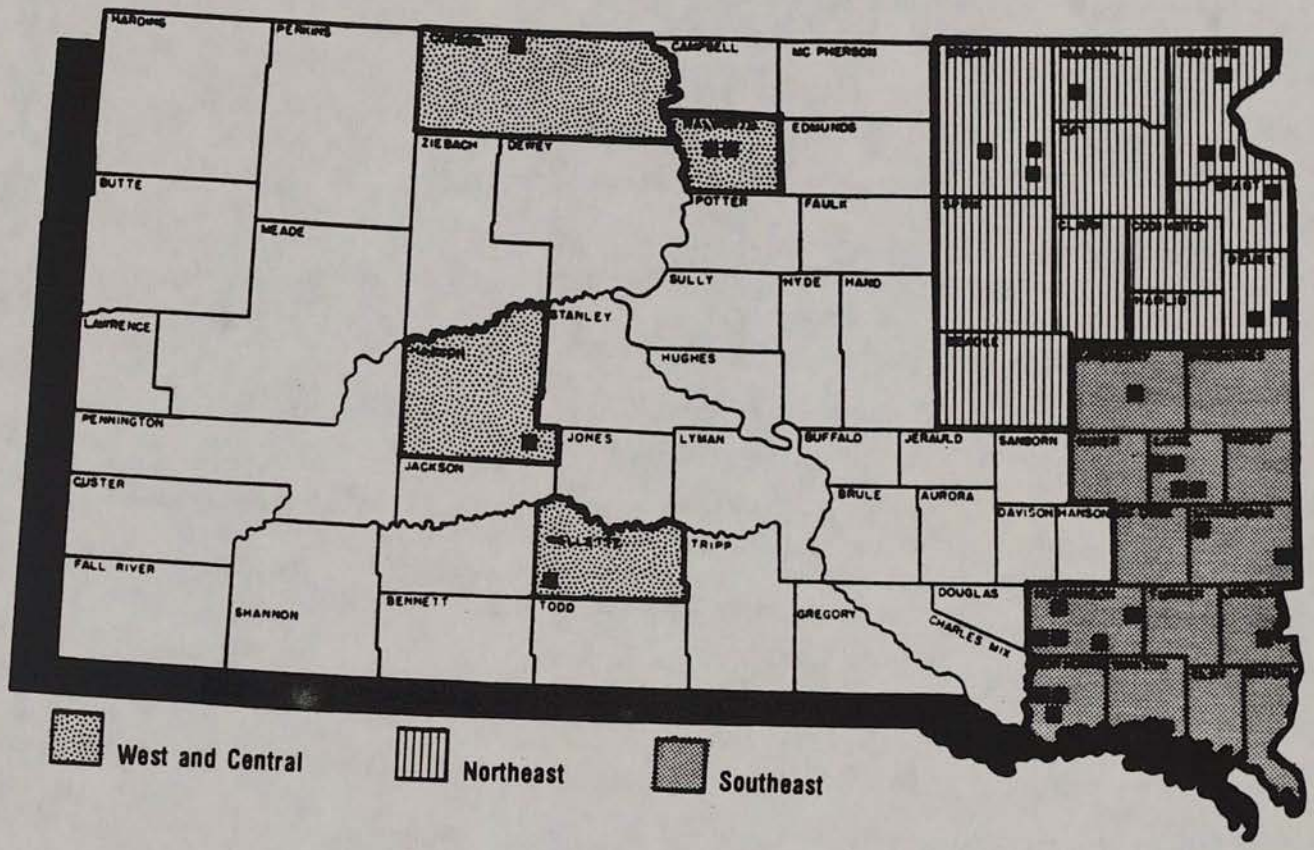

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Table 1. Type of farm, survey respondents.

Type of farm	Number	Percent
Cash grain-livestock	21	65.6
Cash grain	9	28.1
Livestock	2[a]	6.3
TOTAL	32	100.0

[a]One is a dairy farmer; the other involves a beef cow-calf operation.

Table 2. Most important farm enterprises on survey respondent farms.

Crop enterprise	Percent of respondents	Livestock enterprise	Percent of respondents
Soybeans	40.6	Beef cow-calf	46.9
Corn	37.5	Hog finishing	15.6
Wheat	34.4	Hog farrowing	12.5
Oats	18.8	Cattle finishing	12.5
Millet	12.5	Fattening lambs	6.3
Alfalfa	6.3	Dairy	6.3
Rye	6.3	Other	6.3
Other	12.5		

Table 3. Frequency distributions, numbers of farms, by total acreage operated category, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982.

Acreage operated category	Regenerative agriculture farmers		South Dakota farmers[a]			
			All farms		Farms with sales of $10,000 or more	
	Number	Percent	Number	Percent	Number	Percent
1-49	0	0	4,024	10.8	1,052	3.6
50-179	3	9.4	5,248	14.1	2,558	8.7
180-499	8	25.0	9,505	25.6	8,199	27.8
500-999	10	31.2	8,206	22.1	7,782	26.4
1,000-1,999	8	25.0	5,723	15.4	5,524	18.8
> 2,000	3	9.4	4,442	12.0	4,319	14.7
TOTAL	32	100.0	37,148	100.0	29,434	100.0

[a]Based on data from USDC (1984).

Table 4. Frequency distributions, total acreage operated, by acreage operated category, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982.

Acreage operated category	Regenerative agriculture farmers[a]		All farmers[b]	
	Acres	Percent	Acres (millions)	Percent
1-49	0	0	0.1	0.2
50-179	345	1.3	0.6	1.4
180-499	3,010	10.9	3.2	7.3
500-999	6,855	24.9	5.9	13.4
1,000-1,999	10,825	39.4	8.0	18.2
> 2,000	6,445	23.5	26.1	59.5

[a]These acreages are for 31 survey respondents. If the 32nd "giant-scale" farmer respondent (30,000 acres) were included, the respective percentages for the six acreage operated categories would be 0, 0.6, 5.3, 11.9, 18.8, and 63.4.

[b]Based on data from USDC (1984).

Table 5. Average acres of farmland operated in 1988, by type of tenure, survey respondent farms.

Type of farmland	Type of tenure		
	Owned	Rented	Total
Cropland[a]	305[b]	270	610[c]
Conservation Reserve Program (CRP)	5	25	30
Permanent pasture and rangeland	140[d]	75	225[e]
Other	15	5	20
TOTAL	465[f]	375	885[g]

[a]Including set-aside, fallow, and cropland currently being used as hay and pasture.

Notes:

1. The data in this table do not take into account the acreages reported by one "giant-scale" farmer respondent who operates 10,000 acres of owned cropland and 20,000 acres of owned permanent pasture (rangeland). If his acreages were included in the computation of averages, the modified averages would be as follows:

b = 605; d = 760; f = 1,390; and
c = 905; e = 840; g = 1,795.

2. One farmer respondent did not provide information on whether his operated farmland was owned or rented. For this reason, the row totals do not necessarily reflect the sums of the respective average owned and rented acreages.

Table 6. Frequency distributions, numbers of farms, by land tenure category, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982.

Land tenure category	Regenerative agriculture farmers		South Dakota farmers (percentages)[a]	
	Number	Percent	All farmers	Farmers with sales of $10,000 or more
Part owners	19	61.3	44.1	51.9
Full owners	9	29.0	39.9	32.5
Tenants	3	9.7	16.0	15.6
TOTAL	31[b]	100.0	100.0	100.0

[a]Based on data from USDC (1984).

[b]One respondent did not provide information on whether his operated farmland was owned or rented.

Table 7. Frequency distributions, total acreage operated, by land tenure category, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982.

Land tenure category	Regenerative agriculture farmers		All farmers[a]	
	Acres	Percent	Acres (millions)	Percent
Part owners	19,915	75.2[c]	25.6	58.5
Full owners	4,540	17.2[d]	14.3	32.6
Tenants	2,020	7.6[e]	3.9	8.9
TOTAL	26,475[b]	100.0	43.8	100.0

[a]Based on data from USDC (1984).

[b]This is the total acreage for 30 farmers in the survey. One farmer, who operated 1,000 acres, did not provide information on whether his operated farmland was owned or rented. The other farmer owns 30,000 acres of operated land. If the latter farmer's land were included in these calculations, the percentages would be as follows: c = 35.3; d = 61.1; and e = 3.6.

Table 8. Frequency distributions, age of farm operator, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982.

Operator age category (years)	Regenerative agriculture farmers		All farmers (percentages)[a]
	Number	Percent	
25	0	0	4.9
25 - 34	6	19.4	17.4
35 - 44	14	45.2	16.7
45 - 54	5	16.1	21.7
55 - 64	4	12.9	25.2
> 65	2	6.4	14.1
TOTAL	31[b]	100.0	100.0

[a]Based on data from USDC (1984).

[b]One survey respondent did not provide information on his age.

Table 9. Frequency distributions, years of operating present farm, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982.

Length of operating present farm category (year)	Regenerative agriculture farmers		All farmers (percentage)[a]
	Number	Percent	
0 - 2	1	3.4	6.1
3 - 4	1	3.4	9.3
5 - 9	4	13.8	16.8
Subtotal	6	20.6	32.2
10 - 15	8	27.6	n/a
16 - 20	4	13.8	n/a
21 - 25	5	17.3	n/a
28 - 30	1	3.5	n/a
31 - 45	5	17.2	n/a
Subtotal	23	79.4	67.8
TOTAL	29[b]	100.0	100.0

[a]Based on data from USDC (1984).

[b]Three respondents did not provide information on the number of years they have operated their present farm.

Table 10. Frequency distribution, length of experience with regenerative agriculture, survey respondents.

Years of experience category	No. of respondents	Percent
0 - 4	4	13.3
5 - 9	7	23.3
10 - 14	7	23.3
15 - 19	7	23.3
20 - 24	1	3.3
25 - 29	2	6.7
>30	2	6.7
TOTAL	30[a]	99.9[b]

[a]A corporate farm respondent did not provide information on the length of his own personal experience with regenerative agriculture. Another reported that he "has always" farmed regeneratively.

[b]Does not add to 100.0 because of rounding for individual categories.

Table 11. Years farming regeneratively versus years operating present farm, survey respondents.

Regenerative farming versus years of operating present farm status	Number of respondents	Percent
Switched to regenerative farming after starting to operate present farm		
Within 1 to 5 years	2	7.1
Within 6 to 10 years	7	25.0
More than 10 years	5	17.9
Subtotal	**14**	**50.0**
Started farming regeneratively when they started to operate present farm	3	10.7
Were farming regneratively before they started to operate present farm		
For 1 to 5 years	10	35.7
More than 5 years	1	3.6
Subtotal	**11**	**39.3**
TOTAL	28[a]	100.0

[a]Four respondents failed to provide information on the number of years they have farmed regeneratively and/or they have operated their present farm.

Table 12. Reasons for farming regeneratively, both now and at the time of first beginning to farm regeneratively, survey respondents.

Possible reason for farming regeneratively[a]	Degree of Importance[b]					
	Now			When first began		
	Mean	Median	Range	Mean	Median	Range
To be a good steward of the soil	4.88	5	3-5	4.38	5	0-5
To reduce pollution of ground or surface water	4.65	5	3-5	3.81	5	0-5
To raise a residue-free, high quality product	4.50	5	2-5	3.94	4,5	0-5
To reduce possible harmful effects of farm chemicals on the health of the farmer and his family	4.42	5	1-5	4.19	5	1-5
To reduce direct cash costs of farm production	3.77	4	0-5	3.25	4	0-5
To reduce possible harmful effects of farm chemicals on the health of livestock	3.65	4,5	0-5	3.00	3	0-5
To follow religious or philosophical beliefs	3.46	4,5	0-5	2.59	3	0-5
To reduce energy use in farm production	3.19	3	0-5	2.50	3	0-5
To reduce the economic risk resulting from low rainfall	3.00	3	0-5	2.34	2,3	0-5
To overcome the ineffectiveness of plant protection chemicals	2.85	3	0-5	2.63	3	0-5

[a]One respondent indicated an additional reason for farming regeneratively, namely, to allow more of his labor and management to go back on the farm (versus chemicals).

[b]Each respondent rated the relative importance of each possible reason for farming regeneratively on a scale of 0 to 5, where 0 meant not at all important and 5 meant very important. The degree of importance of the various reasons is reflected by the mean, median, and range values for the respective reasons for farming regeneratively ratings--both now and at the time of first beginning to farm regeneratively--by the individual survey respondents.

Table 13. Length of time to complete the conversion from conventional to regenerative farming, survey respondents.

Number of years	Number of respondents	Percent
1	6	37.5
2	1	6.2
3	3	18.8
4	2	12.5
$\geq$ 5	4	25.0
TOTAL	16	100.0

Table 14. Reasons for some cropland not being farmed regeneratively, survey respondents.

Restriction to all cropland being farmed regeneratively	Number of responses	Percent of respondents
Unable to provide the necessary management to farm all cropland regeneratively	4	36.4
Regenerative cropping practices and the renting-in of land do not go well together	3	27.3
Some fields not physically suited for regenerative farming	2	18.2
Newly operated land not yet ready for regenerative farming practices	2	18.2
Other	3[a]	27.3

[a]"Other" restrictions to all cropland being farmed regeneratively are (1) limited markets for regeneratively-produced commodities, (2) having just begun in 1988 to farm regeneratively, and (3) not yet undertaking a new rotation that may enable all cropland to eventually be placed under regenerative cropping practices.

Table 15. Association of regenerative farming experiences and practices with the percentage of cropland farmed regeneratively by survey respondents.

Regenerative farming experience and/or practice	Variable Number	Survey respondent category: percentage of cropland farmed regeneratively[a]		
		100% (19)	60-90% (5)	10-50% (6)
Respondent perceived overall intensity of problems with regenerative agriculture, based on:[b]				
Mean value rating for the 15 possible problems by individual respondents	1	1.27	1.99	2.33
Mean number of observations above the overall median (1.60) for the 32 respondents	2	0.23	0.60	1.00
Years experience with regenerative farming (mean)	3	15.8	15.0	7.8
Percentage of respondents who judge regenerative farming to be more profitable than conventional farming	4	66.7	80.0	40.0
Percentage of respondents who judge regenerative farming to require more labor than conventional farming	5	79.0	80.0	80.0
Percentage of respondents that are officially "certified organic" producers	6	73.7	40.0	50.0
Percentage of respondents that sell regeneratively-raised products through "organic" market outlets	7	68.4	40.0	50.0

[a]The numbers of respondents following regenerative practices on 100%, 60-90%, and 10-50% of their cropland are shown in parens following the respective percentage category designations.

Tests to determine if differences in the values for the respective variables among the three percentage categories are statistically significant were undertaken as follows:

- Variables 1 and 3: ANOVA test of means;
- Variable 2: NPAR1WAY "Median" test of the mean number of observations above the overall median (1.60) for the 32 respondents, evaluated relative to the overall median; and
- Variables 4-7: Chi-Square test of cell frequencies, but with the second and third percentage categories collapsed into one category so as to avoid so few expected observations per cell to negate the validity of the Chi-Square tests [in this latter regard, a cell frequency of less than five expected observations applied to 25% of the cells for Variables 4, 6, and 7 and 50% for Variable 5, thereby implying a somewhat marginal validity of the Chi-Square tests (Siegel, 1956, p 110)].

The results of the testing showed differences in the values among the different percentage categories for all variables except two to be statistically **insignificant (0.10 level)**. The exceptions are Variables 1 and 2, for which a 0.01 level of significance applies.

[b]The basic statistic used in this evaluation is the mean problem rating for the 15 suggested possible problems with regenerative farming for individual respondents.

Table 16. Association of general farm and cropland variables with the percentage of cropland farmed regeneratively by survey respondents.

General farm and/or cropland variable	Variable Number	Survey respondent category: percentage of cropland farmed regeneratively[a] 100% (19)	60-90% (5)	10-50% (6)
Percentage of each farm type, by major source of farm gross sales[b]				
Cash grain-livestock (21)		71.4	40.0	66.7
Cash grain (9)	1	34.8	20.0	0
Livestock (2)		4.8	40.0	33.3
Acres of cropland operated (mean)	2	628	578	2,146
Percent of rented cropland (mean)	3	55.6	52.4	60.7
Percentage of respondents with regular off-farm work	4	23.5	50.0	40.0

[a]Footnote "a" to the preceding table applies in all respects to this table, except for the following:

- An ANOVA test was used for variables 2 and 3 and a Chi-Square test for Variables 1 and 4 in this table;
- With the second and third farm type categories collapsed into one category, a cell frequency of less than five expected observations applied to 25% of the cells for variables 1 and 4, and
- The results of the testing showed differences in the values among the different percentage categories for all the variables in this table to be statistically **insignificant** (0.10 level).

[b]The numbers in parenthesis are the numbers of respondents in the respective farm type categories.

Table 17. Incidence of commodities produced under regenerative practices by survey respondents.

Commodity-grouping and commodity	Percent of respondents	Commodity-grouping and commodity	Percent of respondents
Grains and forages		Livestock	
Corn	59.4	Beef cattle	59.4
Alfalfa	56.3	Hogs	12.5
Wheat	53.1	Horses	9.4
Oats	53.1	Poultry	9.4
Soybeans	43.8	Sheep	6.3
Millet	31.3	Dairy	3.1
Barley	18.8	Llamas	3.1
Rye	18.8		
Buckwheat	9.4	Vegetables and speciality crops	
Flax	9.4	Home garden	6.3
Red clover	9.4	Sunflowers	3.1
Sunflowers	9.4	Sweet corn	3.1
Hay	6.3	Dry beans	3.1
Other[a]	12.5	Unspecified crop	3.1

[a]The "other" grains and forages category reflects one farmer who produces each of "grass and pasture", "sedan grass", "mustard", and "small grains" regeneratively.

Table 18. Levels of synthetic chemical fertilizers, pesticides, and livestock feed additives and growth stimulants used in regenerative production, survey respondents.

Synthetic input	Level of use[a]			
	Zero		Moderate	
	Number	Percent	Number	Percent
Herbicide	20	64.5	11	35.5
Fertilizer	22	73.3	8	26.7
Livestock feed additive (antibiotics)	24	85.7	4	14.3
Livestock growth stimulant	25	89.3	3	10.7
Insecticide	29	96.7	1	3.3
Fungicide	30	100.0	0	0

[a]The percentages below pertain to the respective numbers of farmers with pertinent enterprises and usable responses. To the extent that the numbers of zero- and moderate-level users of particular synthetic inputs do not total 32, one or more respondents failed to provide information for that particular input.

Table 19. Relative importance of alternative nitrogen sources in regenerative crop production, survey respondents.

Possible source of nitrogen[a]	Degree of importance[b] Mean	Median
Prior legume crops in rotation other than soybeans	3.09	4
Green manure legume	2.83	3,4
Crop residues	2.62	3
Livestock manure (not composted)	2.12	2
Prior soybean crop in rotation	1.80	0
Composted livestock manure	1.69	0
Purchased "organic" soil amendments	0.98	0
Purchased commercial "organic" fertilizers	0.91	0
Organic waste products other than livestock manure (e.g., municipal sludge, leaves)	0.73	0

[a]Each of four respondents indicated one additional source of nitrogen: live bacteria (5 rating), nitrogen in air taken in by plants as a result of proper nutrients in the soil that is provided by the seventh year of land rest (5), properly managed summer fallow rotations (3), and snow (2).

[b]Each respondent rated the relative importance of each possible source of nitrogen for each of his/her regeneratively raised crops on a scale of 0 to 5, where 0 meant not at all important and 5 meant very important. The degree of importance of the various sources is reflected by the mean, median, and range values (for each source, the range was 0 - 5) for the respective source-of-nitrogen ratings by different respondents for each of their different crops.

Table 20. Relative importance of alternative nitrogen sources in regenerative crop production, by crop, survey respondents.

Possible nitrogen source	Degree of importance[a]											
	Corn (15)		Wheat (10)		Oats (10)		Soybeans (9)		Alfalfa (5)		All crops (32)	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Prior legume crops in rotation other than soybeans	4.07	5	2.80	4	2.90	3,4	3.00	2,3	1.50	0	3.09	4
Green manure legume	3.29	4	3.80	4,5	2.10	2	2.33	1	1.67	0,5	2.83	3,4
Crop residues	3.00	3	2.80	3,4	1.90	1,2	3.33	3	0.83	0	2.62	3
Livestock manure (not composted)	2.47	3	1.30	0	2.30	2,3	2.00	1	2.33	2	2.12	2
Prior soybean crop in rotation	3.07	5	1.40	0	1.50	0	1.33	0	1.67	0	1.80	0
Composted livestock manure	1.87	0	1.60	0	1.80	0	1.22	0	1.83	1,2	1.69	0
Purchased "organic" soil amendments	0.87	0	1.10	0	1.00	0	0.56	0	2.17	1,2	0.98	0
Purchased commercial "organic" fertilizers	1.13	0	0.30	0	2.00	1,2	0.88	0	1.17	1,2	0.91	0
Organic waste products other than livestock manure (e.g., municipal sludge, leaves)	0.71	0	1.11	1	0.33	0	0.56	0	0.67	0	0.73	0

[a]Each respondent rated the relative importance of each possible source of nitrogen for each of his/her regeneratively raised crops on a scale of **0** to **5**, where **0** meant not at all important and **5** meant very important. The degree of importance of the various sources is reflected by the mean, median, and range values for the respective source-of-nitrogen ratings by different respondents for each of their different crops. The numbers in parentheses following the crop names are the numbers of respondents who provided information on the respective crops.

Table 21. General type of regenerative farming practices, survey respondents.[a]

Type of regenerative farming practice	Those who follow the type of practice	
	Number	Percent
Crop rotations	32	100.0
Special weed control	32	100.0
Special insect and disease control	29	90.6
Tillage and residue management	24	75.0
Grain drying and/or storage	18	56.3
Other[b]	16	50.0

[a]These are regenerative farming practices other than those that involve synthetic chemical inputs.

[b]See Annex 8 for a listing of other special regenerative farming practices reported by the survey respondents.

Table 22. Selected features of crop rotations reported by survey respondents, by region.

Crop rotation features	Southeast	Northeast	Central and west[a]	"State total"
Number of rotations reported	21	10	9	40
Percentage of rotations with:				
At least one small grain	86	90	100	95
At least one row crop	95[b]	90[c]	11	75
At least one forage legume	67	70	44	63
Fallowing	14[d]	30	100[e]	30

[a]For selected counties only; see Figure 1.

[b]Of the 20 farmers including row crops in their rotations in the southeast, 18 raise corn and 14 raise soybeans.

[c]Of the nine farmers including row crops in their rotations in the northeast, six raise corn and three raise soybeans.

[d]One farmers indicates "soybeans or fallow" (rather than simply "fallow") as a component of his rotation.

[e]Two of the nine farmers in this region indicate "clover or fallow", rather than simply "fallow".

Table 23. Regenerative weed control practices, survey respondents.

Weed control practice[a]	Degree of importance[b] Mean	Median	Range
Crop rotations	4.72	5	4-5
Use only certified and/or "clean" seed	2.96	3	0-5
Adjust crop planting dates	2.71	3	0-5
Weed competitive crop selected	2.68	3	0-5
More frequent cultivation	2.59	3	0-5
Harrow	2.42	3	0-5
Mowing (cutting) weeds	2.22	2	0-5
Rotary hoe	2.00	1	0-5
Cover or smother crops	1.76	0	0-5
Narrower row spacing	1.32	0	0-5
Occasional spot-control with herbicides	1.07	0	0-4
Intercropping	0.96	0	0-5
Biological control	0.86	0	0-5

[a]One additional weed control practice included in the questionnaire (namely, a weed burner or flame cultivator) was not reported to be used by any respondent. Each of five respondents indicated one additional weed control practice: deep fall tillage (5 rating), timeliness of all operations (5), 100 years of collective organic experience through four generations (5), hire pullers (5), and composting manure (4).

[b]Each respondent rated the relative importance to his/her farm of each possible regenerative weed control practice on a scale of 0 to 5, where 0 meant not at all important and 5 meant very important. The degree of importance of various weed control practices is reflected by the mean, median, and range values for the respective weed-control-practice ratings by the individual survey respondents.

Table 24. Regenerative insect and disease control practices, survey respondents.

Insect and disease control practice[a]	Degree of importance[b] Mean	Median	Range
Crop rotations	4.54	5	0-5
Adjust crop planting dates	1.89	2	0-5
Cover crops	1.68	0	0-5
Modify tillage practices	1.64	0	0-5
Pest resistant varieties selected	1.57	0	0-5
Biological control[c]	1.03	0	0-5
Modify row spacing/plant density	1.00	0	0-5
Plant derived insecticides (e.g., rotenone, sabadilla, pyrethum, ryania)	0.18	0	0-3
Occasional spot-control with synthetic insecticides and/or fungicides	0.14	0	0-3

[a]One farmer believes that healthy plants repel insects. He focuses on keeping the soil balanced and healthy; the soil in turn keeps the plants healthy and insect free.

[b]Each respondent rated the relative importance to his/her farm of each possible regenerative insect and disease control practice on a scale of 0 to 5, where 0 meant not at all important and 5 meant very important. The degree of importance of various insect and disease control practices is reflected by the mean, median, and range values for the respective insect and disease-control-practice ratings for the individual survey respondents.

[c]Illustrative biological control measures are lady bugs to control aphids, Grandall for flies and mosquitoes, black strap molasses for "bugs," Humates for corn borers, diatomateous earth to control insects in bins, and predator flies.

Table 25. Moldboard plow use on regeneratively farmed land, survey respondents.

Moldboard plow use on regeneratively farmed land	Number	Percent
On no such land	15	46.9
On all such land	11	34.4
On part of such land	6	18.7
TOTAL	32	100.0

Table 26. Instances of regeneratively-raised products being sold through "organic" market outlets, survey respondents.

Product	Number of instances	Percent of respondents[a]
Millet	9	50.0
Wheat	8	44.4
Soybeans	6	33.3
Corn	5	27.8
Flax	4	22.2
Sunflowers	4	22.2
Rye	2	11.1
Beef	2	11.1
Other	4[b]	22.2

[a]These percentages are calculated with respect to the 18 respondents who indicated which commodities they sold through organic market outlets.

[b]The "other" organically-marketed products are alfalfa seed, buckwheat, dry beans, and oats.

Table 27. Share of regenerative production for which a price premium is received, by commodity, survey respondents.[a]

Commodity	No. of observations	Measure of the share (% values) Mean	Mode	Median	Range
Flax	4	100	100	100	100
Wheat	6	92	100	100	50-100
Millet	8	88	100	100	50-100
Sunflowers	3	83	100	100	50-100
Soybeans	6	82	100	80,100	50-100
Corn	4	76	100	100	2-100
Rye	2	55	[b]	10,100	10-100
Beef	2	9	[b]	2,15	2-15

[a]One respondent reported a price premium for shares of each of four regeneratively-raised commodities not shown in the body of the table as follows: 100% for oats, alfalfa seed, and dry beans, and 30% for buckwheat.

[b]No two respondents reported the same percentage of commodity being sold for a price premium for this commodity.

Table 28. Magnitude of price premium received for regeneratively-raised produce, by commodity, survey respondents.[a]

Commodity	No. of observations	Measure of the price premium (%)[b] Mean	Mode	Median	Range
Flax	4	131	[c]	100,150	75-200
Sunflowers	4	94	[c]	50,100	25-200
Millet	9	81	40,100	75	20-200
Corn	4	46	[c]	30,40	12.5-100
Wheat	7	38	30	30	12.5-100
Soybeans	6	30	25	25	22.5-50
Beef	2	22	[c]	10,33	10-33

[a]One respondent reported a price premium for each of five regeneratively-raised commodities not shown in the body of the table as follows: 100% for dry beans, 60% for buckwheat, 50% for oats, 40% for rye, and 10% for alfalfa seed.

[b]These data reflect the percentages by which the prices of regeneratively-raised produce exceed the general prices for conventionally-raised products. For example, "100%" implies a 100% greater (or double) price for regenerative than conventional production.

[c]No two respondents reported the same percentage price premium for this commodity.

Table 29. Judgment of relative crop yields with regenerative versus conventional farming, survey respondents.

Relative crop yields	Number of responses	Percent
Generally greater with conventional farming	17	56.7
About the same with regenerative and conventional farming	5	16.7
Generally greater with regenerative farming	4	13.3
Unsure about differences	3	10.0
Depends on the specific farming enterprise and/or location-specific production conditions	1	3.3
TOTAL	30[a]	100.0

[a]Two respondents did not answer this question.

Table 30. Judgment of relative profitability with regenerative versus conventional farming, survey respondents.

Relative profitability	Number of responses	Percent
Generally greater with regenerative farming	20	66.7
Unsure about differences	5	16.6
Generally greater with conventional farming	2	6.7
About the same with regenerative and conventional farming	2	6.7
Depends on the specific farming enterprise and/or location-specific production conditions	1	3.3
TOTAL	30[a]	100.0

[a]Two respondents did not answer this question.

Table 31. Sources of increased labor requirements with regenerative farming, survey respondents.

Source of increased labor requirement[a]	Degree of importance[b] Mean	Median	Range
More time in weed control, including mechanical cultivation	3.78	4	0-5
More time because of more diverse crop enterprises	2.91	3	0-5
More time in seeking out organic market outlets	2.52	3	0-5
More time because of adding livestock to what otherwise would be only a cash grain farm	1.09	0	0-5
More time in crop insect and disease control	0.78	0	0-3

[a]Each of six respondents indicated one additional source of increased labor requirements: greater timeliness of operations is required (5 rating), requires haying labor at busy times (4), manual weed control on beans (4), more machines (4), planning and study (3), and filling out farm certification papers and responding to organic farming questionnaires (3).

[b]Each respondent rated the relative importance of each possible source of increased labor requirement from farming regeneratively rather than conventionally on a scale of 0 to 5, where 0 meant not at all important and 5 meant very important. The degree of importance of the various sources is reflected by the mean, median, and range values for the regenerative source-of-increased-labor-requirement ratings by individual respondents.

Table 32. Continuing and transition problems with sustainable agriculture, survey respondent farmers.

Possible problem with sustainable agriculture[a]	Degree of importance[b]					
	Continuing problem			Transition problem		
	Mean	Median	Range	Mean	Median	Range
Difficult to find organic market outlets	2.83	3	0-5	2.83	3	0-5
Lack of up-to-date and accurate information on sustainable agriculture	2.45	2	0-5	3.09	3	0-5
Receive personal ridicule from neighbors	2.21	2	0-5	2.96	3	0-5
Increased weed problems	2.07	2	0-5	3.30	4	0-5
Crops experience nitrogen shortages	1.97	2	0-5	2.78	3	0-5
Organic fertilizer and soil amendments are costly	1.93	2	0-5	2.52	3	0-5
Tough to cope with management requirements	1.86	2	0-5	2.48	3	0-5
Difficult to find adequate organic waste products (manure, compost, industrial)	1.79	2	0-5	2.22	2	0-5
Forces me to reduce my base acreage in the Federal farm program	1.55	0	0-5	1.78	1	0-5
Creditors are reluctant to grant loans	1.21	0	0-5	1.57	2	0-5
Forces me to have less farmland in high valued crops	1.10	0	0-5	1.57	1	0-5
Lack of pest resistant varieties	0.97	0	0-4	1.17	0	0-4
Forces me to be a livestock farmer	0.59	0	0-5	0.83	0	0-5
Increased insect problems	0.52	0	0-2	1.26	1	0-4
Increased disease problems	0.41	0	0-2	1.17	0	0-4

[a]Each of four respondents indicated one additional problem with sustainable agriculture: having to cope with the pollution of the land rented from others (5 rating), moisture in dry years--green manuring (5), pollution from neighbors (2), and increased labor requirements (2).

[b]Each respondent rated the relative severity of each possible problem with sustainable agriculture on a scale of 0 to 5, where 0 meant not at all important and 5 meant very important. The degree of importance of various problems is reflected by the mean, median, and range values for the problem-ratings by the individual survey respondents.

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ANNEX 1

QUESTIONNAIRE, 1988 MAIL SURVEY

1988 MAIL SURVEY
TO : SOUTH DAKOTA REGENERATIVE AGRICULTURE FARMERS
FROM: SDSU ECONOMICS AND PLANT SCIENCE DEPARTMENTS

INTRODUCTION

1. Do you consider yourself to be a regenerative farmer (check one)?

   ___If no, stop! Please return the questionnaire in the enclosed envelope.
   ___If yes, please proceed to answer the questionnaire.

BACKGROUND INFORMATION ON FARM

2. By type of enterprise, how would you classify your farm? [Check the one source that typically provides 50% or more of your annual farm gross sales, and for that one response check the most important individual farm enterprise(s).]

   ___Cash grain [___corn ___soybeans ___wheat ___other (specify: _____)]

   ___Livestock [___beef cow-calf ___fat cattle ___dairy ___hog farrowing ___hog finishing ___raising feeder lambs ___fattening lambs ___other(specify:_____)]

   ___Cash grain-livestock (check the applicable farm enterprises above)

   ___Other (specify: _____)

3. Are you a participant in the 1988 federal farm commodity program (check one)?

   ___ Yes
   ___ No

4. How many acres of farmland, by type of tenure, are you operating in 1988 (complete all that apply)?

	Acres (to the nearest 10 or 20)		
Type of farmland	Owned	Rented	Total
Cropland, including set-aside, fallow, and that currently being used as hay and pasture	____	____	____
Conservation Reserve Program (CRP)	____	____	____
Permanent pasture and rangeland	____	____	____
Other (e.g., woodland, farmstead)	____	____	____
Total	____	____	____

5. Do you use a moldboard plow on your regeneratively farmed land (check one)?
   ___ Yes, on all of it
   ___ Yes, on part of it
   ___ No, on none of it

6. For the person with primary responsibility for decision-making on your farm,

   a. What is your current age? _____ years
   b. How many years have you operated your present farm? _____ years
   c. Do you also have regular off-farm work? ___ Yes ___ No [If yes, for approximately how many working days per year? _____ days]

7. Do you have livestock on your farm (check one)?
   ___ Yes [If you were not a regenerative farmer, would you probably have livestock anyway? ___Yes ___No]
   ___ No [If you don't have livestock, please disregard the two livestock-related inputs in Question 9 below.]

YOUR REGENERATIVE PRODUCTION

8. For what commodities do you follow regenerative practices? [Check as many commodity-groupings as apply, and for each checked response indicate the enterprise(s) on the blank lines.]

   ___ Grains and/or forages [_____, _____, _____, _____, _____, _____]

   ___ Livestock [_____, _____, _____, _____, _____, _____]

   ___ Vegetables or other speciality crops [_____, _____, _____, _____, _____, _____]

   ___Other (specify: _____)

9. What level of synthetic chemical fertilizers, pesticides, and growth stimulants do you use in your regenerative production?

	Check the level of use that most appropriately describes your practices for each synthetic input		
Synthetic input	Zero use	Only moderate use[a]	Conventional use
Fertilizer	_____	_____	_____
Herbicide	_____	_____	_____
Insecticide	_____	_____	_____
Fungicide	_____	_____	_____
Livestock growth stimulant	_____	_____	_____
Livestock feed additive (antibiotics)	_____	_____	_____
Other (specify: _____)	_____	_____	_____

[a]If you use a moderate quantity of the product, please indicate something about the level of use and/or the conditions under which you use the input.

10. In addition to your practices regarding synthetic chemicals, what farming practices do you follow on your regeneratively farmed land? [Check all main responses that apply, and for each main response checked please provide the additional information requested.]

_____a. Crop rotations [If so, please indicate on the next lines your one or two main crop rotations and below that the main reasons why these rotations appear to work well and/or are troublesome for you.]

i. _____, _____, _____, _____, _____, _____
ii. _____, _____, _____, _____, _____, _____

Reasons why rotations work well and/or are troublesome in my organic farming:

_____b. Tillage and residue management practices (if so, please describe what they are)

_____c. Special weed-control practices (If so, please indicate the relative importance to your farm of each possible practice on a scale of 0 to 5, where 0 means not at all important and 5 means very important.)

___Weed competitive crops selected
___Use only certified and/or "clean" seed
___Adjust crop planting dates
___Narrower row spacing
___Rotary hoe
___Harrow
___More frequent cultivation
___Occasional spot-control with herbicides
___Mowing (cutting) weeds
___Weed burner (flame cultivator)
___Biological control (specify:___
_____
_____)
___Crop rotations
___Intercropping
___Cover or smother crops
___Other (specify:_____
_____)

_____d. Special insect and disease control practices [If so, please indicate the relative importance to your farm of each possible practice on a scale of 0 to 5, where 0 means not at all important and 5 means very important.]

___Pest resistant varieties selected
___Adjust crop planting dates
___Modify row spacing/plant density
___Crop rotations
___Cover crops
___Modify tillage practices
___Biological control (specify:_____
_____)
___Plant-derived insecticides (e.g., rotenone, sabadilla, pyrethrum, ryania)
___Occasional spot-control with synthetic insecticides and/or fungicides
___Other (specify:_____
_____)

-cont'd on next page-

Question 10 cont'd.

_____e. Special drying and/or storage practices (If so, please describe what they are)

_____f. Please describe below any other regenerative farming practices that you follow.

11. In what year did you first begin to farm regeneratively? _____

12. Is all of your cropland farmed regeneratively in 1988? [Please check "yes" or "no", and provide the additional information requested for your selected response.]

___If yes, how many years did it take for you to complete the conversion from conventional to regenerative farming? _____years

___If no,

a. What percentage (roughly) of your cropland is now farmed regeneratively? _____
b. Why is only part of your cropland farmed regeneratively (check all that apply)?

___Some fields are not physically suited for regenerative farming
___Regenerative cropping practices and the renting of land do not go well together
___I am unable to provide the necessary management to farm all my cropland regeneratively
___The market for regeneratively-produced commodities is too limited to take all the production from my cropland
___Regenerative farming is less profitable than conventional farming
___Other (specify: _____)

13. This question is intended to determine why you farm regeneratively--both at the time when you first decided to farm regeneratively and now. For each time period, indicate the relative importance of each possible reason on a scale of 0 to 5, where 0 means not at all important and 5 means very important. [If you have farmed regeneratively for only 2 or 3 years, please disregard the "now" column.]

Possible reasons for farming regeneratively	0 to 5 rating, for each time period: When first began	Now
To be a good steward of the soil	_____	_____
To raise a residue-free, higher quality product	_____	_____
To reduce pollution of ground or surface water supplies	_____	_____
To reduce energy use in my farm production	_____	_____
To reduce direct cash costs of farm production	_____	_____
To overcome the ineffectiveness of plant protection chemicals	_____	_____
To reduce possible harmful effects of farm chemicals on the health of me and my family	_____	_____
To reduce possible harmful effects of farm chemicals on the health of my livestock	_____	_____
To reduce the economic risk resulting from low rainfall	_____	_____
To follow my religious or philosophical beliefs	_____	_____
Other (specify: _____)	_____	_____

14. In your raising of regeneratively-produced crops, what do you consider to be the relative importance of each of the following nitrogen sources? [Please indicate the name of each regeneratively-produced crop, and the relative importance of each source of nitrogen on a scale of 0 to 5, 0 means not at all important and 5 means very important. If you're unsure, simply check here._____]

Possible source of nitrogen	For each of your principal crops (specify which ones immediately below), your 0 to 5 rating: Crop 1 (_____)	Crop 2 (_____)	Crop 3 (_____)
Purchased commercial "organic" fertilizers	_____	_____	_____
Purchased "organic" soil amendments	_____	_____	_____
Prior soybean crop in rotation	_____	_____	_____
Other prior legume crops in rotation	_____	_____	_____
Green manure legume	_____	_____	_____
Crop residues	_____	_____	_____
Livestock manure (not composted)	_____	_____	_____
Composted livestock manure	_____	_____	_____
Organic waste products other than livestock manure (e.g., municipal sludge, leaves)	_____	_____	_____
Other (specify:_____)	_____	_____	_____

MARKETING YOUR REGENERATIVELY-RAISED PRODUCE

15. Are you an officially "certified organic" producer (check one)?

_____If yes, via what program (agency) are you certified (check as many as apply):

___Farm Verified Organic (FVO)
___Organic Growers and Buyers Assoc (OGBA)
___Organic Crop Improvement Assoc (OCIA)
___Other (specify:_____)

_____If no, please indicate why you are not an officially "certified organic" producer.

16. Do you sell at least part of your regeneratively-raised produce through "organic" market outlets (check one)?

_____If no, please indicate why not and then go on to Question 21.

_____If yes, please proceed to the next question.

17. Through which "organic" market outlet do you most commonly sell your regeneratively-raised products?

Sale outlet	For each product (specify which ones immediately below) check as many sale outlets as apply: Product 1 (_____)	Product 2 (_____)	Product 3 (_____)
Wholesale buyer (e.g., Mercantile Development, Inc., CEO Little Bear Trading Co.)	_____	_____	_____
Farmers' market	_____	_____	_____
Roadside stand	_____	_____	_____
Direct to "organic food" outlets	_____	_____	_____
Pick-your-own	_____	_____	_____
Other (specify:_____)	_____	_____	_____

18. Do you receive any organically-based price preimium for your regeneratively raised produce (check one)?

_____If no, please go to Question 21.
_____If yes, please proceed to the next question.

19. For each regeneratively-raised product for which you receive a price premium, roughly what percentage of your production is sold for a premium and what is the approximate percentage price premium that you receive for the product?

Name of regeneratively raised product	Percentage of your regenerative production for which a price premium is received[a]	For that sold at a premium, by what percentage does the price exceed the general prices for conventionally-raised products?[b]

a. If less than 100% of your regeneratively-raised produce is sold for a price premium, please briefly explain why.

b. In the next 2 or 3 years, do you expect the price premium(s) to ____increase, ____decrease, or ____probably remain the same, or are you ____uncertain? If you have checked "increase" or "decrease", please briefly explain why.

20. How do you market your regeneratively-raised produce (check one)?

____As an individual seller
____Collectively with others. If so, please briefly describe the nature of your collective arrangement and your views on its advantages and disadvantages.

21. Please briefly describe what you have learned until now about the (a) opportunities for and (b) limitations to the effective marketing of regeneratively-raised products.

YOUR EVALUATION OF REGENERATIVE AGRICULTURE

22. This question concerns possible problems (difficulties) with regenerative agriculture.

a. The first column below is for you to portray what you view as apparent continuing problems with regenerative agriculture. Please rate the relative severity of each possible problem on a scale of 0 to 5, where 0 means not at all important and 5 means very important.

b. The second column is intended to reflect special transition problems, i.e., problems that arise when converting from conventional to regenerative farming. These transition problems may be exaggerated forms of what later are continuing problems, or they may arise during the transition but essentially disappear "by the end of the transition period." In the second column, please show your 0 to 5 level-of-importance rating for each possible transition problem.

	0 to 5 rating for each possible problem with regenerative agriculture	
Possible problem	Continuing problem	Transition problem
Lack of pest resistant varieties		
Crops experience nitrogen shortages		
Increased weed problems		
Increased insect problems		
Increased disease problems		
Organic fertilizer and soil amendments are costly		
Difficult to find adequate organic waste products (manure, compost, industrial)		
Creditors are reluctant to grant loans		
Lack of up-to-date and accurate information on regenerative agriculture		
Difficult to find organic market outlets		
Receive personal ridicule from neighbors (either directly or indirectly)		
Tough to cope with management requirements		
Forces me to reduce my base acreage in the Federal farm program		
Forces me to have less farmland in high valued crops		
Forces me to be a livestock farmer		
Other (what are they?)		
i. _____		
ii. _____		

Please select two of the most important problems you have experienced with regenerative agriculture. For each, indicate (i) what you have done to try to overcome the problem, (ii) whether you've been successful, (iii) the apparent explanation for "success-cases", and (iv) for "unsuccessful-cases" whether you now think you are "going to have to live with it" or have some further ideas for overcoming it (if the latter, what are they?). [Please answer on next page.]

Problem 1

Problem 2

23. What is your judgment on relative crop yields and the relative profitability of regenerative versus conventional farming, once transitional problems are overcome?

Relative situation	For each column, check the one best response: Yields	Profitability
Generally greater with regenerative farming	____	____
Generally greater with conventional farming	____	____
About the same with regenerative and conventional farming	____	____
Depends on the specific farming enterprise and/or location-specific production conditions	____	____
Not sure	____	____

Please indicate why you believe the relative yields and profitability of regenerative and conventional farming are as you have just indicated.

Crop yields

Profitability

24. In your judgment, does following regenerative rather than conventional farming practices add to the labor requirements of farming (check one)?

___If no, please go to Question 26
___If unsure, please go to Question 26
___If yes, please proceed to the next question

25. On a scale of 0 to 5 (with 0 meaning not at all important and 5 meaning very important), how important is each of the following in causing your labor requirements with regenerative farming to be greater than if you farmed conventionally?

Possible cause of added labor requirement	Relative importance (0 to 5 for each possible cause)
More time in weed control, including mechanical cultivation	_____
More time in crop insect and disease control	_____
More time because of more diverse crop enterprises	_____
More time because of adding livestock to what otherwise would be only a cash grain farm	_____
More time in seeking out organic market outlets	_____
Other (specify: _____)	_____

26. What are your future plans in following regenerative farming practices? [Check the one most appropriate response and indicate why you respond as you do.]

___I intend to continue to follow regenerative farming practices
___I intend to no longer follow regenerative farming practices
___I am unsure
Why:

27. Would you be willing to share more detailed information about your experience with regenerative agriculture if a visit to your farm were scheduled later this year or early next year (check one)?

___If no, that's okay!
___If yes, please enter your name, address, and telephone number below.
Name: _____
Address: _____
_____
Tel. No.: _____

28. Would you like to receive a copy of the results of this survey (check one)?

___No.
___If yes, please be sure your name and address are shown above.

29. We thank you for completing this questionnaire. If you have any additional comments, please provide them below.

30. Please return the questionnaire in the enclosed envelope.

ANNEX 2
SURVEY STUDIES OF SUSTAINABLE AGRICULTURE FARMERS

Report	Nature of survey (No. of respondents)	Years of survey	Geographic focus	Commodity focus	Primary subject matter focus
Altieri, et al., 1983	Mail survey, 120 organic farmers	n/a	California	Fruits, vegetables, nuts, some rice	Agronomic management strategies, soc constraints, biological features, economics; apple production case stu
Baber and Smith, 1987	Mail survey, 62 organic farmers; a follow-up personal interview of 10 farmers	1986	New York	Highly diverse, vegetables, fruits, specialty crops, livestock	Problems with organic farming, information sources, farmer perspect adequacy of land grant university research in meeting their needs
Berardi, 1978	Personal interviews with 10 organic and 10 conventional farmers	1974-75	New York	Winter wheat	Comparative energy and overall econc inputs and output
Blobaum, 1984	Survey of 214 organic farmers	n/a	Illinois, Iowa, Minnesota, Missouri, Nebraska	Grains, livestock, vegetables, fruit, eggs	Barriers to switching from conventic to organic farming methods
Buttel and Gillespie, 1988; Buttel, et al., 1988	Mail surveys of 72 organic and 324 "small" and "commercial" conventional farmers	1987	New York	n/a	Comparative study of preferences fo reduced input production practices (assuming no differences in yields a profits)
Foster and Miley, 1983	Mail survey of 58 organic farmers and 32 organic nonfarmers, with follow-up personal interviews	n/a	Kansas	n/a	An exploratory study of organic farm and organic nonfarmers (consumers)
Harris, et al., 1980	Mail survey of 96 organic and 378 conventional farmers	1978	Michigan	Highly diverse, grains, livestock, fruits, specialty crops	Compare the characteristics and practices for organic and conventio farmers
Klepper, et al., 1977; Lockeretz, et al., 1976; Lockeretz, et al., 1977; Lockeretz, et al., 1978[1]	Personal interviews and subsequent mail survey, 14 matched pairs of organic conventional Corn Belt farmers	1974-76	Illinois, Iowa, southern Minnesota, northern Missouri, eastern Nebraska	Field crops, livestock	Comparative study of yields, labor, requirements, profits, energy use intensity, and soil erosion loss wi organic versus conventional farm production practices
Lockeretz and Madden, 1987	Mail survey of 58 Midwestern organic farmers	1987	Iowa, northern Illinois and Missouri, southern Minnesota, eastern Nebraska	Field crops	Determines changes in perceptions a experiences of organic farmers who been studied 10 years earlier, (Wer and Lockeretz, 1987) with added attention in 1987 to the financial status of the farms
Lockeretz, et al., 1980[1]	Direct measurement of corn yields on 26 matched pairs of organic and conventional farmers	1975-78	Northern Illinois, Iowa southern Minnesota, Missouri, eastern Nebraska	Corn	Comparative corn yields on matched of organic and conventional farms, comparative effects of organic and conventional practices on soil prop
Madden, 1987	Mail survey and follow-up telephone interviews with 344 expected organic farmers in 1981 (250 of the 344 responded in 1986); the respondents included organic and mixed organic and conventional farms, plus a small number of conventional farms	1981 and 1986	California (vegetables, fruits, nuts), Idaho (field crops and general crops), Kansas (wheat, cash grain), Maine diversified, with vegetables and melons most common), Oregon (vegetables and melons), Pennsylvania (dairy), Washington (wheat, grain)		Acreage, gross sales, herd size, cr pest control measures, fertility farms; advantages of organic farmin
Shearer, et al., 1981[1]	Survey of 23 organic farmers	1977-78	Mainly Iowa, also northern Illinois, southern Minnesota	Crop enterprises on beef and hog farms	Comparison of yields, cropland use, operating expenses, net returns, ar energy use intensity on sampled org farms versus all-farm averages for respective counties from which the organic farms were selected
Vail and Rozyne, 1982	Three hour personal interviews with 31 small organic farmers (over an 8-month period)	1978	Maine	Vegetables (?)	Soil management practices on small organic farms; main attention to sc amendments
Wernick and Lockeretz, 1977[1]	Mail survey of 174 midwestern organic farmers	1977	Illinois, Iowa, Minnesota, Missouri, Nebraska	Field crops	Motives for and perceived advantage and disadvantages of farming organi production practices of organic fa

[1]The following reports reflect findings from the four referenced surveys: Lockeretz and Wernick (1980) and Lockeretz, et al. (1981

ANNEX 3

TABULAR PRESENTATION, REGIONAL BREAKDOWNS

REGENERATIVE AGRICULTURE SURVEY RESPONDENTS

Note: Where data are presented in the following tables for "all South Dakota farmers in 1982", the source is USDC (1984).

Annex 3, Table 1. Type of farm, by region in state, survey respondents.

Type of farm	Southeast No.	Southeast %	Northeast No.	Northeast %	Central and west[a] No.	Central and west[a] %	32 farmers No.	32 farmers %
Cash grain-livestock	12	75.0	5	45.5	4	80.0	21	65.6
Cash grain	3	18.8	5	45.5	1	20.0	9	28.1
Livestock	1	6.2	1	9.0	0	0	2	6.3
Total	16	100.0	11	100.0	5	100.0	32	100.0

[a]For selected counties only; see Figure 1.

Annex 3, Table 2. Regional variations in most important farm enterprises, survey respondents.

Selected enterprises	Percentage of respondents having the selected enterprise: Southeast	Northeast	Central and west[a]	32 farmers
Beef cow-calf	69.2	40.0	100.0	46.9
Soybeans	46.7	62.5	20.0	40.6
Corn	53.3	50.0	0	37.5
Wheat	13.3	50.0	100.0	34.4

[a]For selected counties only; see Figure 1.

Annex 3, Table 3. Regional variations in the average size of farm, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982.

Region in South Dakota	Mean farm size (acres per farm)	
	Regenerative agriculture farmers	All farmers
Southeast	580	399
Northeast	685[a]	727
Selected counties in central and western S.D.[b]	2,265	2,727
"State total"	885[a]	1,271

[a]These are the means for 31 survey respondents. If the 32nd "giant"-scale survey respondent's acreage were included, the mean acreages would be as follows: Northeast 3,350; "State total" 1,795.

[b]For the selected counties, see Figure 1.

Annex 3, Table 4. Regional variations in the percentage of rented land operated, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982.

Region in South Dakota	Percentage of rented land	
	Regenerative agriculture farmers	All farmers
Southeast	41.3	n/a
Northeast	43.1[a]	n/a
Selected counties in central and western S.D.[b]	50.5	n/a
"State total"	42.4[a]	16.0

[a]These are the percentages for 31 survey respondents. If the 32nd "giant"-scale survey respondent's acreage were included, the percentages would be as follows: Northeast 7.0%, "State total" 20.9%.

[b]For the selected counties, see Figure 1.

Annex 3, Table 5. Regional variations in age of farm operator, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982.

Region in South Dakota	Regenerative agriculture farmer ages (years) Mean	Range	All farmer mean age (year)[a]
Southeast	38.1	27-60	47.7
Northeast	51.9	39-72	47.7
Selected counties in central and western S.D.[b]	42.4	31-62	48.2
"State total"	43.7	27-72	49.0

[a]The regional means are weighted means of county averages, where the county average farm operator ages are weighted by the respective numbers of farms in the counties comprising each region.

[b]For the selected counties, see Figure 1.

Annex 3, Table 6. Regional variations in the years of operating present farm, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982.

Region in South Dakota	Regenerative agriculture farmers (years) Mean	Range	All farmer mean (years)[a]
Southeast	15.4	3-35	18.7
Northeast	23.9	2-40	19.8
Selected counties in central and western S.D.[b]	18.8	7-43	20.1
"State total"	18.9	2-43	19.8

[a]The regional means are weighted means of county averages, where the county average years of operating the present farm are weighted by the respective numbers of farms in the counties comprising each region.

[b]For the selected counties, see Figure 1.

Annex 3, Table 7. Regional variations in the incidence of off-farm employment for farm operators, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982.

Region in South Dakota	Percentage of farmers having off-farm employment	
	Regenerative agriculture farmers	All farmers
Southeast	30.8	40.6
Northeast	50.0	40.0
Selected counties in central and western S.D.[a]	0	37.2
"State total"	33.3	40.0[b]

[a]For the selected counties, see Figure 1.

[b]Thirty three percent of all farm operators in South Dakota with farm sales of $10,000 or more have off-farm employment.

ANNEX 4

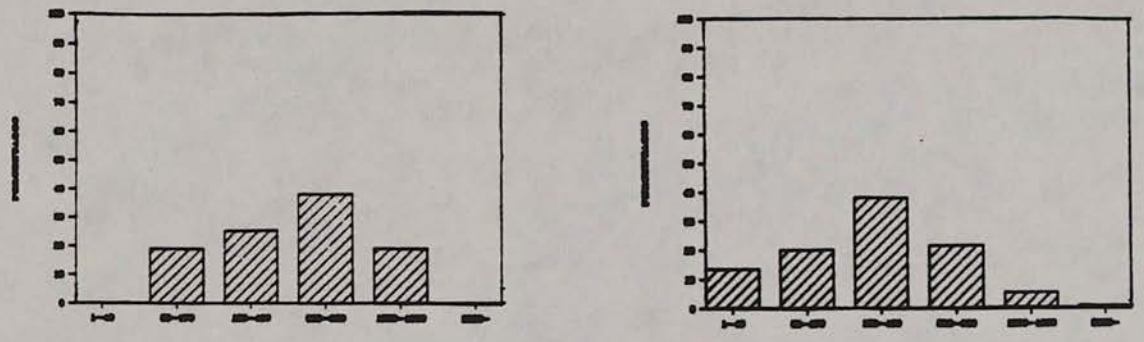
CHART PRESENTATION, REGIONAL BREAKDOWNS

REGENERATIVE AGRICULTURE SURVEY RESPONDENTS

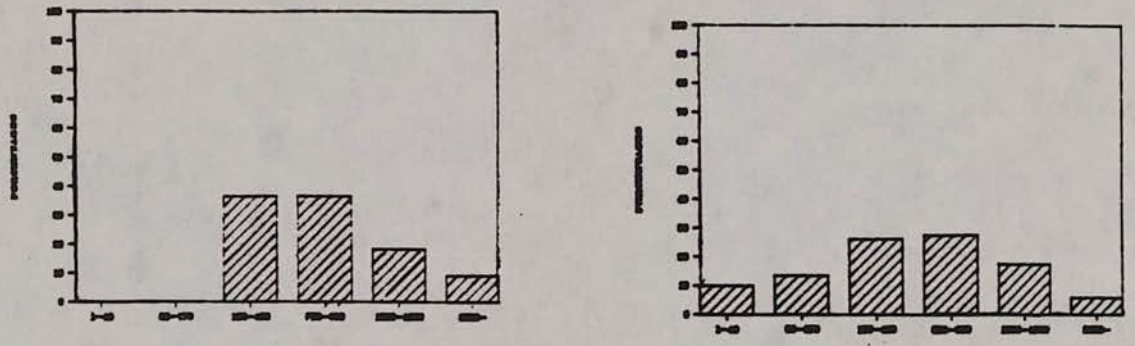
Note: See Figure 1 for an indication of the boundaries for the "southeast" and "northeast" regions and the selected counties covered in the "central and west." Data in the following charts for "all South Dakota farms" are for 1982 as reported in USDC (1984).

South Dakota regenerative farmers

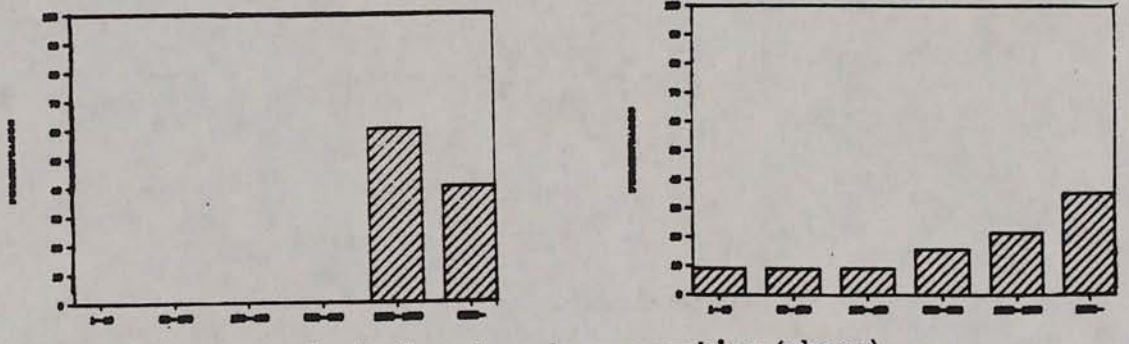
All South Dakota farmers



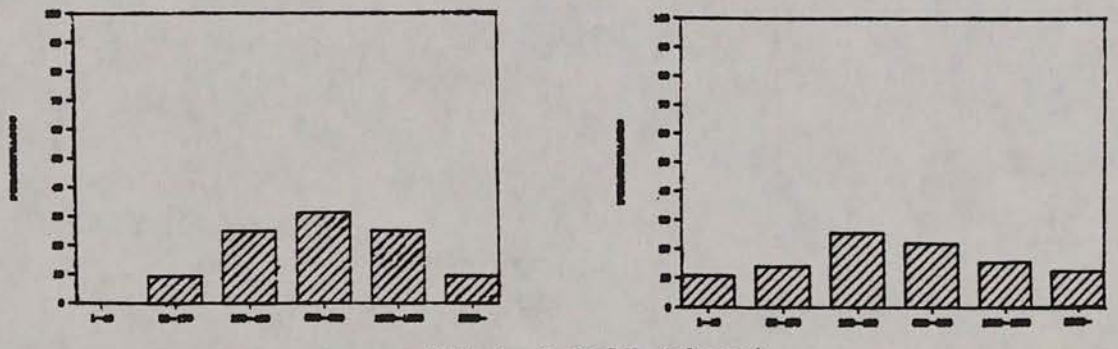
Southeast region (above)



Northeast region (above)

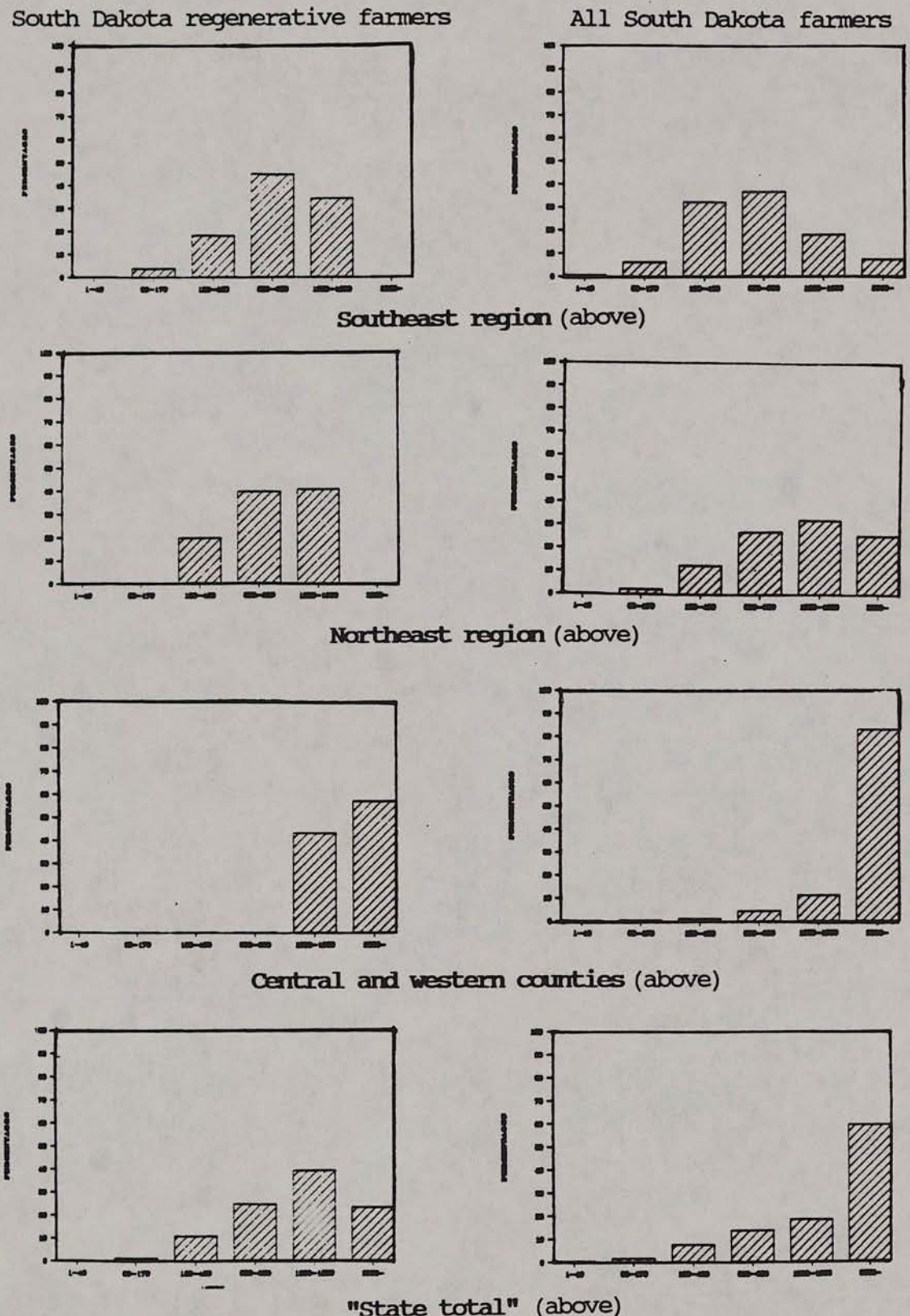


Central and western counties (above)



"State total" (above)

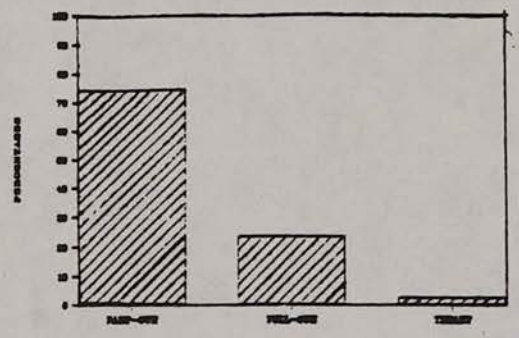
Annex 4, Figure 1. Frequency distributions, numbers of farms, by total acreage operated category, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982, by region.

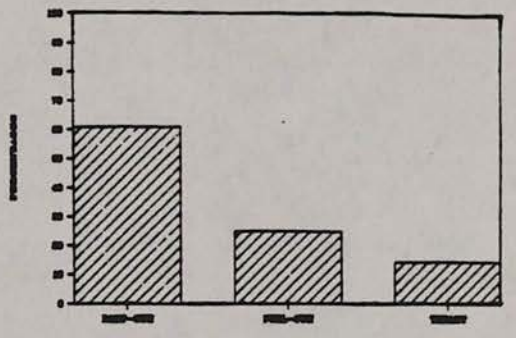


Annex 4, Figure 2. Frequency distributions, total acreage operated, by acreage operated category, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982, by region.

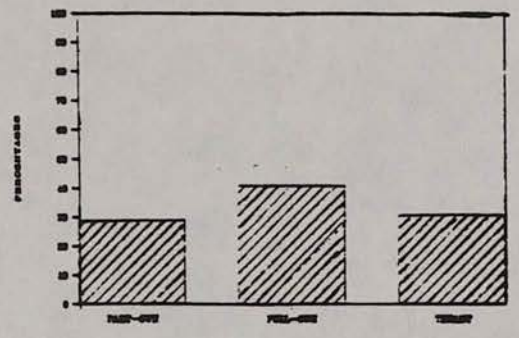
South Dakota regenerative farms

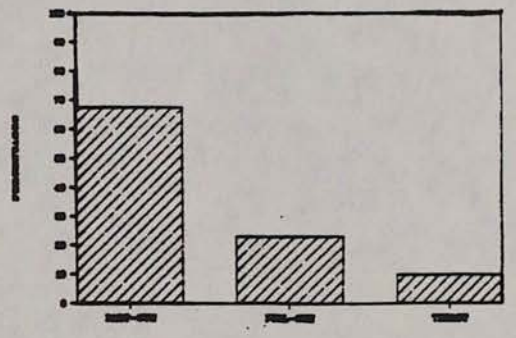
All South Dakota farms



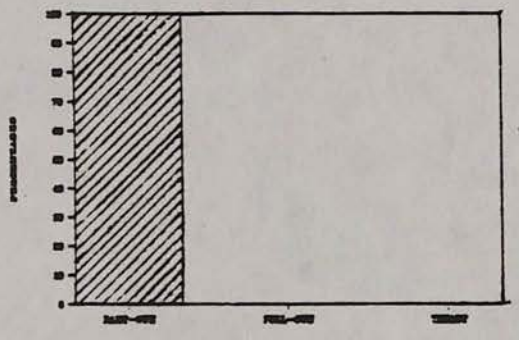


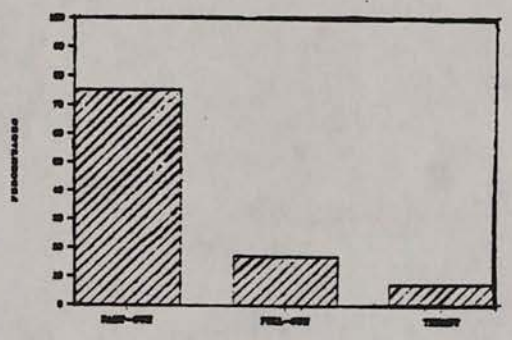
Southeast region (above)



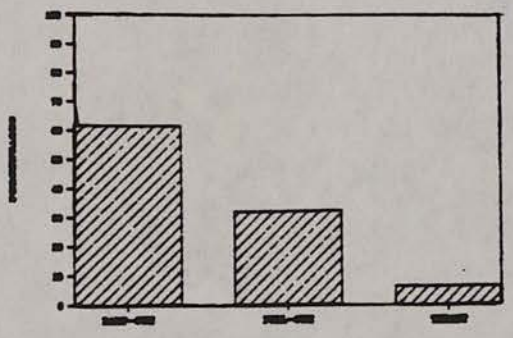


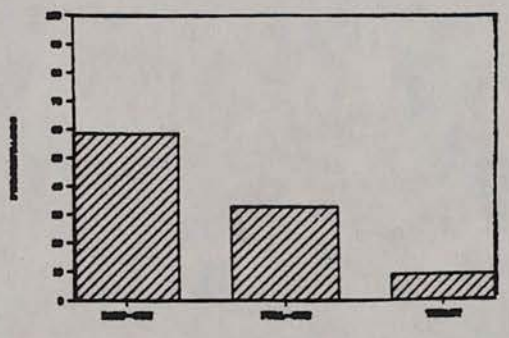
Northeast region (above)





Central and western counties (above)



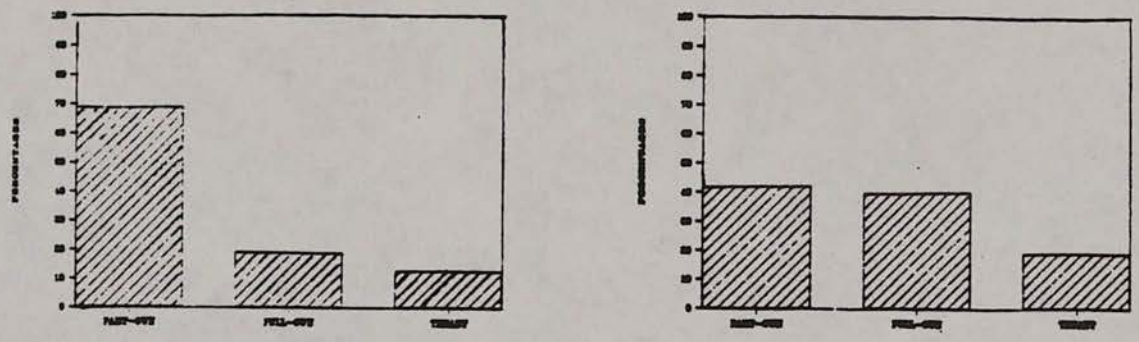


"State total" (above)

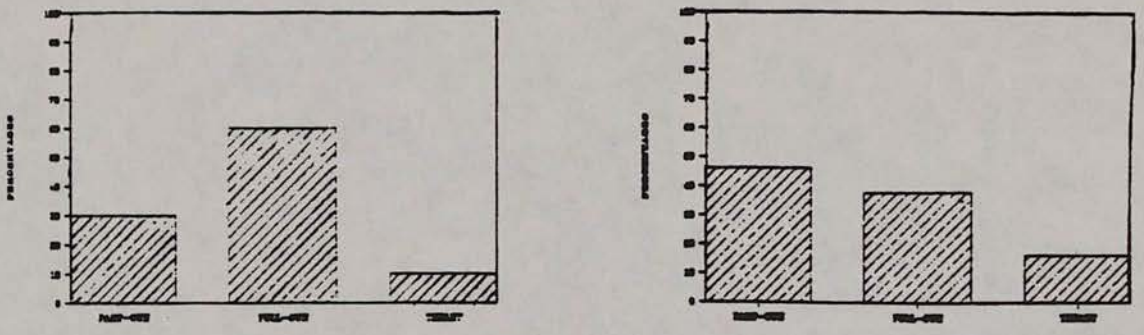
Annex 4, Figure 3. Frequency distributions, numbers of farms, by land tenure category, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982, by region.

South Dakota regenerative farms

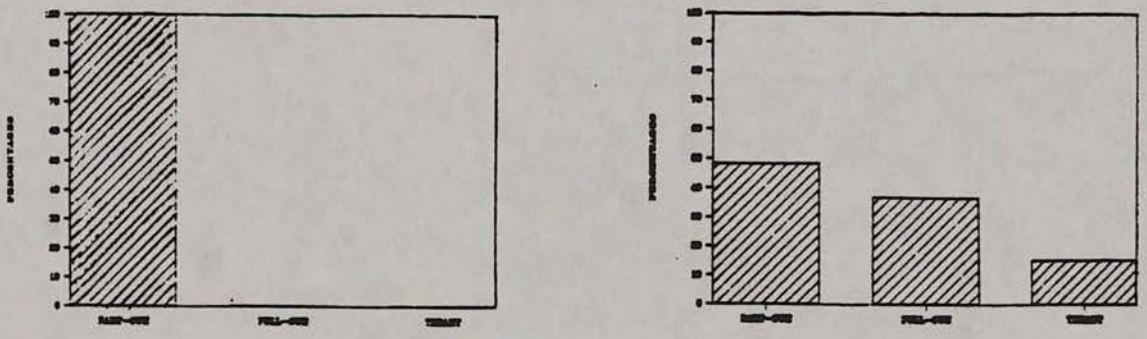
All South Dakota farms



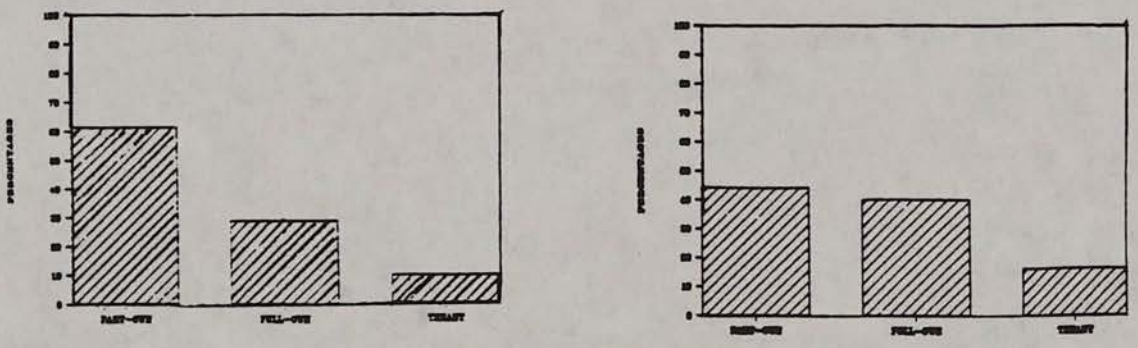
Southeast region (above)



Northeast region (above)

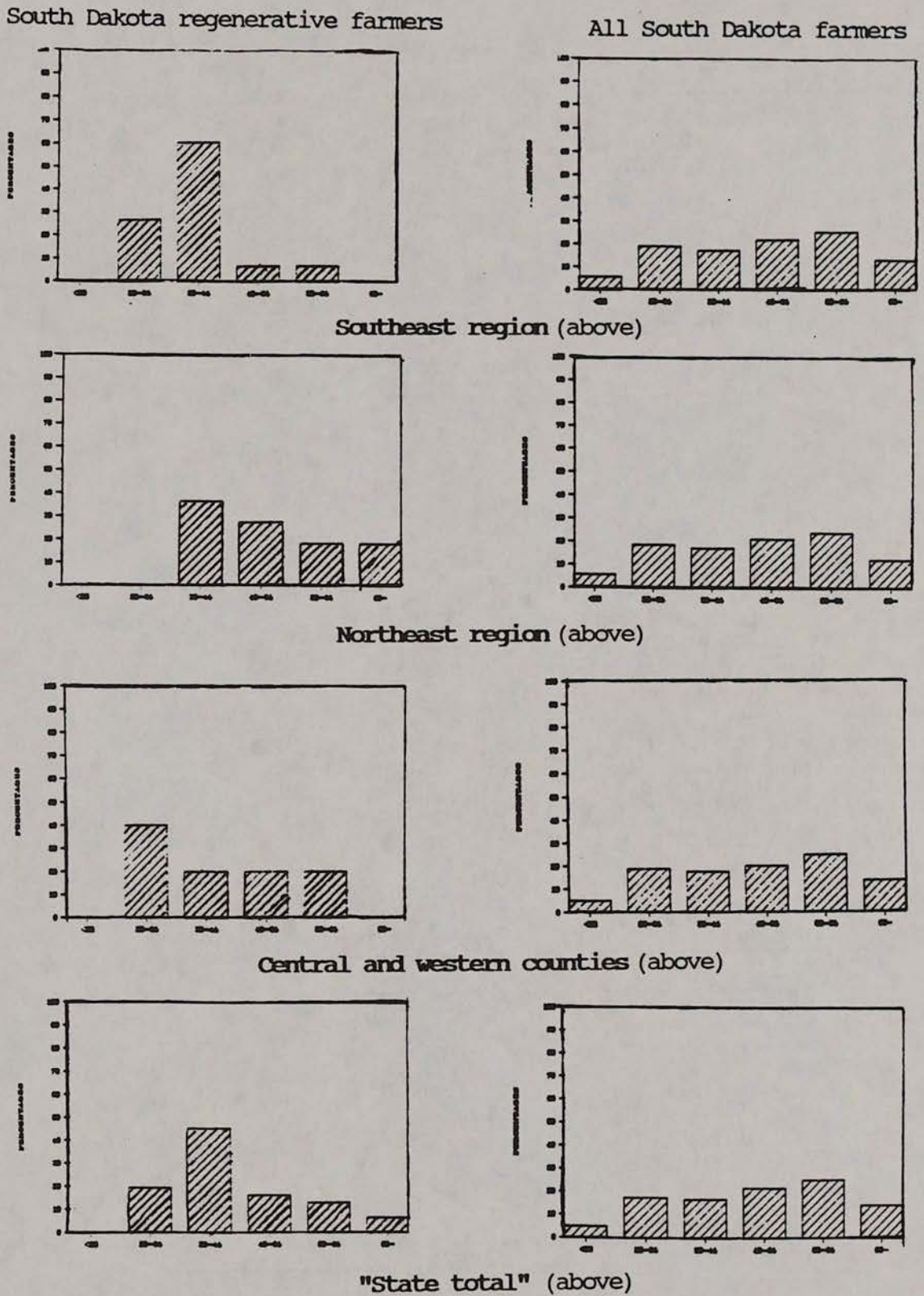


Central and western counties (above)

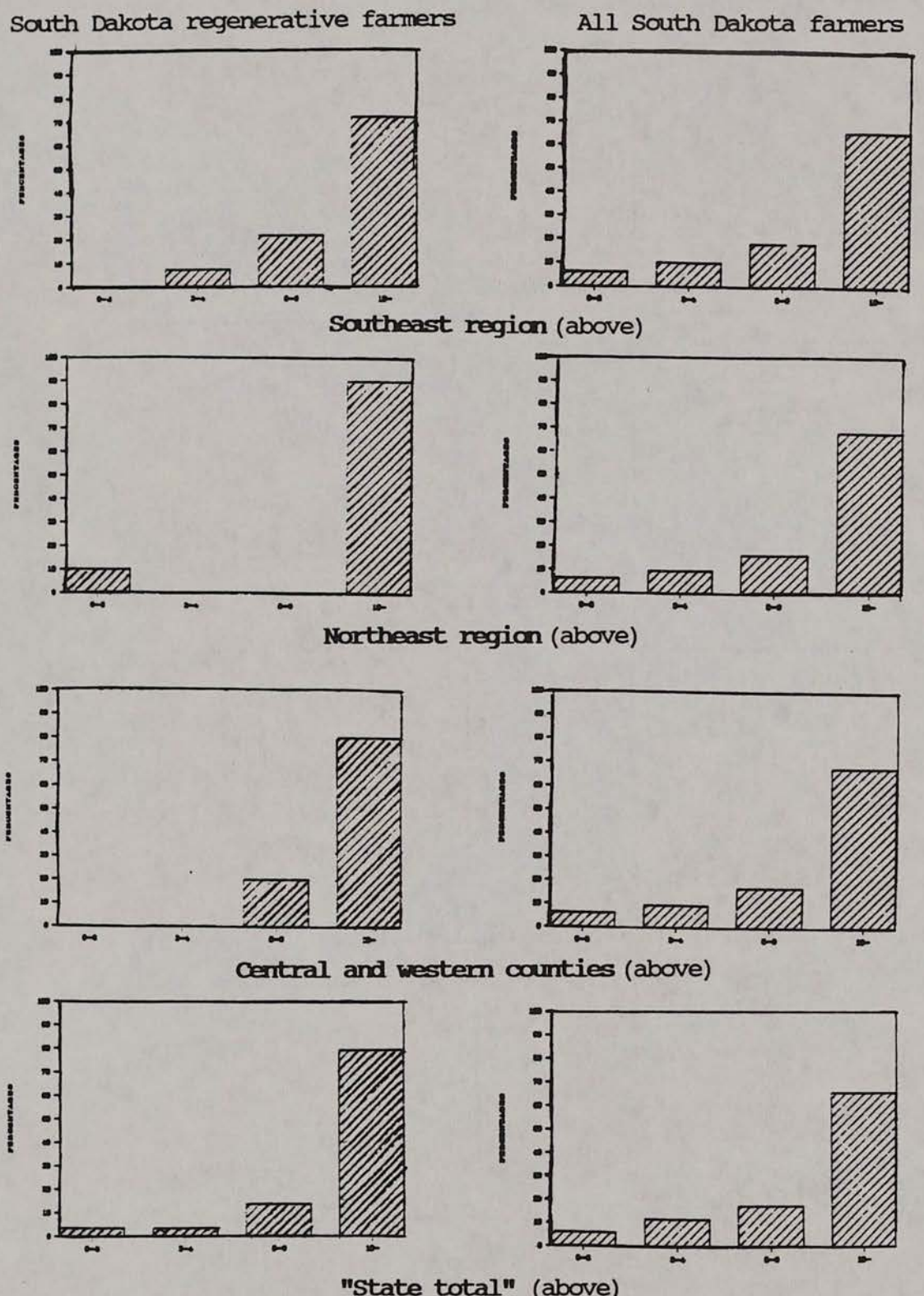


"State total" (above)

Annex 4, Figure 4. Frequency distributions, total acreage operated, by land tenure category, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982, by region.



Annex 4, Figure 5. Frequency distributions, age of farm operator, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982, by region.



Annex 4, Figure 6. Frequency distributions, years of operating present farm, regenerative agriculture survey respondents in 1988 versus all South Dakota farmers in 1982, by region.

ANNEX 5

CROP ROTATIONS

REGENERATIVE AGRICULTURE SURVEY RESPONDENTS, BY REGION

A. Crop rotations followed

Southeast

1. Corn, oats, soybeans, corn, oats, sweet clover, corn
2. Corn, oats, alfalfa or flax, corn, sweet clover, flax
3. Corn, small grain, alfalfa, alfalfa, soybeans, corn, small grain or sweet clover, soybeans
4. Corn, small grain, alfalfa, soybeans
5. Corn, alfalfa, oats
6. Corn, alfalfa, flax, soybeans, wheat, soybeans, corn
7. Corn, oats, alfalfa, soybeans
8. Corn, oats, alfalfa
9. Corn, soybeans
10. Corn, clover or soybeans, grain
11. Corn, oats, wheat, corn, oats, wheat[a]
12. Corn, oats, millet, corn, oats, millet[a]
13. Oats, alfalfa
14. Soybeans, rye, soybeans, rye
15. Small grain and clover, corn, soybeans or fallow, beans
16. Corn, soybeans, oats, red clover, alfalfa
17. Wheat, soybeans
18. Corn, oats, corn, oats, alfalfa, oats
19. Corn, oats or small grain, soybeans, corn, oats (small grain), soybeans
20. Corn, soybeans, oats, sweet clover, wheat
21. Corn, soybeans, corn, oats, alfalfa, alfalfa

Northeast

22. Oats or barley, sweet clover or fallow, rye, millet, HRS wheat
23. Oats, sudan or clover, clover or fallow, HRS wheat, rye or millet
24. Wheat, barley, fallow
25. Oats, wheat, fallow, alfalfa
26. Fallow, wheat (sweet clover)
27. Corn, oats, fallow
28. Winter wheat, millet, summer fallow, winter wheat
29. Oats, millet, wheat, summer fallow, alfalfa
30. Wheat, millet or buckwheat, fallow, wheat, buckwheat or millet, fallow[b]

[a]Every seventh year, this farmer's cropland "rests idle", with a sweet clover or forage sudan cover crop.

[b]Every seventh year, this farmer's owned cropland "rests idle".

Selected central and western counties

31. Corn, soybeans
32. Corn, wheat, barley, alfalfa
33. Corn, small grain, sweet clover, summer fallow, rye, corn
34. Corn, wheat, soybeans, alfalfa
35. Rye, sunflowers, millet, summer fallow
36. Grain, grain, row crop, grain, alfalfa
37. Grain, sweet clover, grain, row crop, grain, alfalfa
38. Corn, oats
39. Corn, wheat, oats, millet, soybeans, alfalfa, soybeans
40. Small grain, legumes, summer fallow

B. Farmer insights on the roles of crop rotations in regenerative agriculture

Southeast

1. I use alfalfa to clean up fields with weed problems. The following few years are good for crops like soybeans and flax.

2. One year of alfalfa is the best weed control I have found.

3. Wheat and soybeans follow each other very well because soybeans leave a lot of nitrogen for wheat and leave the field in good tilth for the needed early planting of wheat.

4. I am just in the first stages of a soybeans-rye-soybeans-rye rotation, but this looks promising for weed control and fertility. Alfalfa is rotated more frequently into our weed-prone fields to control the weeds.

Northeast

5. Rotation is a must in my farming. The sweet clover works well as green manure and helps in weed control. Rye and millet also help in weed control.

6. If I follow summer fallow with rye and two other crops, I have no weed problems.

7. I started using alfalfa for weed control. Getting the alfalfa plowed down can be a problem, however.

8. In a corn-small grain-sweet clover-summer fallow-rye-corn rotation, I have trouble getting enough nitrogen.

9. Every seventh year, I do not farm the land. I let whatever grows, grow. The land produces the type of plant necessary to produce the nutrients it needs. Most of the time, the plants are weeds. After the seventh year, I have no problems with those weeds for six years. The underlying idea is from the book, "Weeds--Guardians of the Soil".

Selected central and western counties

10. By following wheat with buckwheat or millet, I find that wheat is less susceptible to disease such as crown rot, mosaic, Hessian fly, and root rot. Also, the buckwheat and millet seem to put something in the soil that wheat likes; wheat yields have increased significantly. The referenced rotation is wheat-millet-fallow-wheat-buckwheat-fallow.

11. Rye is great for weed control and organic matter. Also, varying planting seasons beats the weeds.

12. I plant millet after wheat because millet can grow on a small amount of rain, controls weeds, and has a mellowing effect on the soil. It gives me great flexibility on planting dates.

13. On my corn-oats-fallow rotation, a plow-down of green sudan works well.

ANNEX 6

TILLAGE AND RESIDUE MANAGEMENT PRACTICES

REGENERATIVE AGRICULTURE SURVEY RESPONDENTS, BY REGION

Southeast

1. I chisel plow in the fall on alfalfa or small grain stubble, disc cornstalks in the fall, disc all stubble ground once in the spring, field cultivate before planting row crops, and rotary hoe soybeans and corn.

2. I use a chisel plow and offset disc to keep more crop residue on the surface.

3. I try to avoid plowing, except when eliminating old alfalfa or putting under a green manure cover crop. I have quit growing soybeans because they loosen the soil so much that hill erosion in the spring is a problem.

4. I chisel alfalfa, disc corn stalks, and field cultivate ahead of soybeans and corn.

5. I plant row crops late (corn by the end of May, soybeans early June) so that beforehand I can till in two or three crops of weeds and grass. Also, by this time grass has usually quit growing. As much residue as possible is left on the land year-round, although weed control is a primary concern. The last tillage before planting is done with a field cultivator to fluff the soil and discourage weed growth.

6. We chisel plow the bean stubble only between the row, leaving the bean stubble stand to maintain residue and nitrogen fixation. Some wheat is wasted intentionally after the combine to provide cover for the winter. The wheat stubble is moldboard plowed to clean the field of weeds. The plowing also improves soil tilth for good soybean stands.

7. Spring plowing reduces erosion. Plowing down sweet clover helps organic matter.

8. Following the harvest of oats in the fall, I use an offset disc and chisel plow. Soybean tillage is not done in the fall.

9. In the fall, I disc corn stalks with either a regular or plowing disc, and then I V-rip (sub-soil). On soybean ground, I V-rip only. Both approaches leave good residue.

Northeast

10. I do very little fall plowing or tillage.

11. I plow and packer-pony press in everything.

12. I do no fall plowing or digging, only the Noble Blade. My disc is retired for the year by July 1st.

13. Right after combining, I disc to kill the weeds and then chisel plow before the soil freezes. This opens the soil so that the snow melt and early spring rains will soak in.

14. I moldboard plow oat stubble early so as to get regrowth to stop erosion in winter and spring. I chisel corn ground. Due to the 1988 drought, I will do no moldboard plowing this year, however.

Selected central and western counties

15. I use a chisel (Nobel Blade) plow with crown sweeps. Large equipment on small farms makes for timely operations.

16. By following wheat with millet and buckwheat, my fields stay cleaner longer -- thus reducing tillage.

17. I leave ground cover on the land when possible, leaving stubble in the field until spring.

ANNEX 7

SPECIAL GRAIN DRYING AND/OR STORAGE PRACTICES

REGENERATIVE AGRICULTURE SURVEY RESPONDENTS, BY REGION

Southeast

1. We use early-maturing varieties of corn and soybeans so as to get mature crops early in the fall. If artificial drying is necessary, we use low heat.

2. I let my corn dry in the fields and pick it on the ear.

3. We usually bin grains 1 to 2 points dryer than normal recommendations, dust bottoms of bins with diotomateous earth, and try not to store grains for prolonged periods.

4. I have a solar drying grain bin and use natural air drying with my ear corn.

5. I use aeration with my grain.

6. We use air flow to dry shelled corn, but each year we pick more corn on the ear.

7. They (presumably buyers) want corn picked and crib dried; this is not practical for small quantities.

Northeast

8. I use a drying floor with my grain.

9. I air dry my corn and mustard seed in 1-2,000 bu. bins.

10. I have used acid on my corn. I try to combine late enough to have naturally dry corn.

11. I use an air bin with my grain.

12. I do no artificial drying.

13. I windrow-dry the crop down to safe keeping and store it in clean dry bins. I have a good granary that I vacuum each fall before putting in new grain.

Selected central and western counties

14. I am very careful of the moisture level of the crop harvested. My combine is set to clean vigorously. If the harvested crop is dirty, however, I clean it before storage. Diatomateous earth is applied generously around the base of the bin and around the door when filling the bin. The top 1,000 bu. of grain is checked bimonthly in fall and spring.

15. I use natural air drying and aeration.

ANNEX 8

OTHER SPECIAL REGENERATIVE FARMING PRACTICES

REGENERATIVE AGRICULTURE SURVEY RESPONDENTS, BY REGION

Southeast

1. Our total program is to develop life in the soil. We use a soil conditioner to open up the soil and get the air and water flowing. We use a live bacteria each year to enhance the life in the soil. We totally agree with Dr. John Doran (USDA scientist), "The greater the biologic life in the soil, the more fertile it is."

2. We use manure from our dairy enterprise.

3. We have invited the townspeople to bring out leaves, grass clippings, and organic residues. We cover about 15 acres annually with compost.

4. Trashwhippers on my planter allow planting under almost any condition. I have a COA spraying for weeds that allows you to cut your chemical application rate in one-half. I've used an organic fertilizer on all my land for four years (for six years on some land). I have also sprayed some micro-organisms.

5. Livestock manure is left in pack until it can be hauled and tilled in quickly. The cow-calf herd is supplied with a naturally derived lick of protein; vitamins A, B, D. and E; and salt.

6. We have bought some rock fertilizers, compost our manure some, plan to add soil microbes to our land, and have used some seed innoculants.

Northeast

7. I use liquid bacteria "agri-serum" and "basic H" on all my cropland every year. The bacteria promote good life in the soil; "the life in the soil is the fertility". The basic H I use enhances nutrient releases in the soil and increases protein in the plants.

8. I apply my manure to alfalfa ground. If weed seeds are present in the manure and sprout, I can mow the weeds when I put up the hay.

9. I follow many dozens of techniques and mini-systems which do not lend themselves to proper description in this space.

Selected central and western counties

10. My cattle (beef cow-calf operation) are fed only grain and hay produced on my farm. They receive no growth hormones, only killed viruses and vaccines and salt and minerals. (Note: He does not sell his animals through organic market outlets.)

11. I do not have enough manure to cover all my farm, so I put it (composted) on the tops of the hills and knolls where the topsoil needs replacing.

ANNEX 9

REASONS FOR NOT BECOMING AN OFFICIALLY "CERTIFIED ORGANIC" PRODUCER

REGENERATIVE AGRICULTURE SURVEY RESPONDENTS

1. I knew it was possible for Iowa and Minnesota farmers to be "certified organic", but did not know that South Dakota farmers could be.

2. Most processors and marketers of "organic" foods are dishonest profiteers. They charge exorbitant prices for foods that should be priced lower to attract market share.

3. I still band my crops with minimum levels of herbicides.

4. The requirements for certification are unclear to me.

5. I haven't considered it yet.

6. I still spot spray problem areas with herbicide.

7. There's no demand for organically produced commodities.

8. My product does not qualify (moderate use of fertilizer and herbicides).

9. All my crops are fed to livestock. There's no market for "certified organic" livestock.

10. I am attempting to get certified by FVO and OCIA.

11. To get certified requires too much red tape and too many restrictions.

ANNEX 10

REASONS WHY LESS THAN 100% OF REGENERATIVELY-RAISED PRODUCE IS SOLD FOR A PRICE PREMIUM

REGENERATIVE AGRICULTURE SURVEY RESPONDENTS

1. My wheat does not have high enough protein content. Not enough people want to buy halves of beef.

2. There's no demand for organic corn in large quantities.

3. Not all of my regeneratively-raised produce is sold for a price premium because of limited storage facilities and cash needs (cannot always wait for an organic marketing opportunity). Also, in small share-rented fields, my share of the produce goes to "town" with the landlord's share.

4. Cash-flow problems force me to sell my beef at the regular auction market. I haven't yet tried to sell any feeder calves as organically-raised feeders.

5. There's no market (for rye).

6. Transportation eats me up, and sometimes they do!

7. There's a lack of demand and sometimes I can't meet quality standards (moderate quantities of herbicides on some soybean fields).

8. In early years, the demand was not as good as it is now. The last couple of years I have sold 80-90% of my regenerative produce through organic markets. It takes time to find organic market outlets.

ANNEX 11

WHAT HAS BEEN LEARNED UNTIL NOW ABOUT
THE OPPORTUNITIES FOR AND LIMITATIONS TO THE
EFFECTIVE MARKETING OF REGENERATIVELY-RAISED PRODUCTS

REGENERATIVE AGRICULTURE SURVEY RESPONDENTS

1. I have found that reputation builds a market for and the price of regeneratively-sold produce. Markets are expanding overseas and on the U.S. coasts. Existing organic wholesalers ought to begin to warehouse purchased product to alleviate individual producers of having to develop their own storage facilities and to be vulnerable to cash flow problems--which arise because of the uncertain timing of purchases by the wholesalers.

2. In my area, there seem to be a number of people that prefer chemical-free products. Many, however, also want all the other factors in produce (e.g., taste, tenderness) to remain the same. So, marketing involves educating too.

3. People are very conscious about their money and would sooner take a chance with their health by buying cheap food as to support the producers of "good" food with a somewhat higher price.

4. Adequate storage is essential.

5. If you can find your own private markets, your product can be a lot more cost effective.

6. Organic marketing requires a little more scheduling and coordinating of delivery than regular marketing, but it is not prohibitive. Delayed payment is the biggest disadvantage.

7. There aren't too many places to sell organically-raised produce.

8. Marketing opportunities do exist; there are some very reputable companies to deal with. However, shipping distances to cleaning plants--and extensive time and telephone costs to arrange for marketing--can be too great to be profitable. I sometimes encounter difficulties in getting paid for product. A marketing network system would be helpful.

9. The consumer will generally buy what is cheap and convenient. A small percentage will buy for health reasons. The only way to establish a market share for these products is to become vertically integrated (grow, process, package, sell), produce for a specific market (cheap, convenient, health), and promote (advertise).

10. Anyone that tests the feeding value of grains grown with our program which puts life in the soil via live bacteria will immediately see the results (perhaps a 20% improvement in livestock performance because of reduced intake, more rapid gains, and better health). The biggest problem is getting accurate measurements.

11. In low populated regions, marketing opportunities are limited.

12. I feel there is a large portion of the population in the U.S. that would gladly pay more for clean food. However, the advertising and promotion are inadequate at this time. Most of the organic products go to Europe where people are better educated to the dangers of chemicals in food.

13. It takes cooperation from growers to sell effectively (he sells his regeneratively-raised produce collectively).

14. So far, we have made a free ride for crooks. But what goes around, comes around. I'm sure it will change; it might happen over night; people are funny. The chances of getting cancer used to be one in a 100; now it is one in four.

15. The organic market has gotten larger each year. The buyers insist on real organic products; they spot check to see that products are pure and chemical free. The passage of Senate Bill 214 this year should help in this regard.

16. The consuming public is becoming more aware of all the toxins in the food they eat; they are starting to buy more organic food; hence the market for regeneratively-raised produce is improving. The present food industry is a big conglomerate; it's hard to compete with them. Ultimately, it will be consumers who turn the market around in favor of organic.

17. I find the organic market to be too small.

18. Regenerative farmers have to live near bigger cities.

19. Opportunities are present, but one must work hard at finding markets. In some cases there's not enough demand for products.

20. I have found there is a market for my products, but you have to go looking for it. The primary limitations are distance to processor and storage of product.

21. Opportunities seem to be increasing yearly. The limitations are finding organic markets that are already in operation.

22. My regeneratively-raised spring wheat has been found to be high in protein and high in falling numbers.

ANNEX 12

REPORTS IN THE LITERATURE
COMPARATIVE YIELDS WITH SUSTAINABLE VERSUS CONVENTIONAL PRACTICES

- Berardi (1978) reports wheat yields in New York under conventional practices to be 29% higher than under organic practices;

- Klepper, et al. (1977) report conventional corn and soybean yields on Corn Belt farms in 1975 (good production conditions) to be 27% and 9%, respectively, higher than organic yields; in moisture-short 1974, however, conventional corn yields were only 3% higher and conventional soybean yields were actually 9% less than matched organic yields;

- Lockeretz, et al. (1980) report mean corn yields under favorable growing conditions on conventional fields to be 8.5% higher than on matched organic fields of midwestern farmers, but the yield difference was not statistically significant; under adverse conditions, conventional yields were less than organic yields;

- Lockeretz, et al. (1978) report higher mean yields for 1974-76 on conventional than matched organic midwestern farms of the following magnitudes: wheat 31%, corn 8%, soybeans 6%, and oats 2%;

- Lockeretz, et al. (1981) report yields over five years for five midwestern states on conventional farms to be higher than those on organic farms by the following amounts: wheat about 25%, corn about 10%, soybeans about 5%, and oats and hay about equal; and

- Shearer, et al. (1981) report all-farmer yields to compare with organic farmer yields in the midwest as follows: in 1977, corn 8% higher, soybeans about the same, and oats 10% less; and in 1978, corn 18% higher, soybeans 7% higher, and oats 6% less, with only the 1977 oat and 1978 corn yield differences being statistically significant.

ANNEX 13

REPORTS IN THE LITERATURE
COMPARATIVE PROFITS WITH SUSTAINABLE VERSUS CONVENTIONAL PRACTICES

- Harris, et al. (1980) report the median organic farm in their Michigan study to break even financially, while the median conventional farm netted $1,625 per year;

- Klepper, et al. (1977) report average returns above variable production costs in 1974 and 1975 for midwestern matched pairs of organic and conventional farms to be roughly comparable;

- Lockeretz, et al. (1978) report the same general outcome as Klepper, et al. (1977), except that data for 1976 were also included in the analysis;

- Lockeretz, et al. (1981) report essentially the same outcome for 1974-1977 as that reported by Klepper, et al. (1977) and Lockeretz, et al. (1981) but 13% lower net returns for the organic farms in 1978 when production conditions were unusually favorable; and

- Shearer, et al. (1981) report no significant differences in average returns over operating expenses for individual crops in 1977 and 1978 for surveyed midwestern organic farmers relative to comparable all-farm averages, except for oats in 1977, when organic net returns were significantly greater; and at the whole-farm level, net returns for the organic farms were 4% (a non-statistically significant difference) higher in 1977 and 13% (statistically significant) lower during the well above-average growing conditions of 1978.

ANNEX 14

REPORTS IN THE LITERATURE
COMPARATIVE LABOR REQUIREMENTS WITH SUSTAINABLE VERSUS CONVENTIONAL PRACTICES

- Harris, et al. (1980) report less hired labor on Michigan organic than conventional farms as follows:

* 11% and 25% of the respective types of farms employ some permanent or full-time hired laborers;

* 36% and 47% employ some seasonal or part-time hired laborers; and

* 68 and 140 mean days worked by hired laborers (if any);

- Berardi (1978) reports the average hours of farmer labor per hectare in New York to be 13 for organic farmers (21 if an old-order Amish farmer is included) and 9 for conventional farmers--a 44% difference; and

- Klepper, et al. (1977), Lockeretz and Wernick (1980), and Lockeretz, et al. (1981) report average labor requirements per acre for midwestern farmers following organic practices to be 3.3 hours versus 3.2 hours for those following conventional practices--a 3% difference.

ANNEX 15

NATURE OF PROBLEMS AND APPROACHES FOR DEALING WITH PROBLEMS WITH SUSTAINABLE AGRICULTURE

REGENERATIVE AGRICULTURE SURVEY RESPONDENTS, BY REGION

Southeast

1. In small grains, I can now produce as well as my neighbors. Sometimes, like last year, my oats were considerably better than theirs. In corn, however, I have never been able to compete. One reason is because I refuse to raise hybrid corn. Corn developers have not tried to produce a good quality open-pollinated corn seed. We save our own seed and have improved the quality. Just this year, markets are opening up for my open-pollinated corn, so I think my return per acre will be as high as the neighbors with less expenses.

2. Regenerative practices are difficult to successfully introduce in soils that are high in pH or high in magnesium.

3. In marketing organic beef, we have tried to find health food stores or individuals and have not met with success. Now, I am trying to sell yearlings to organic feed lots. There seems to be a big market potential for beef, but the big problem is that the stores want a big amount the year round. Farmers and ranchers need to band together in meeting market needs.

4. Weeds are a problem with organic farming. Cover crops, such as sweet clover and sudangrass, have worked in well with the ASCS set-aside program. You just have to live with more weeds.

5. Storage is essential for marketing organic grain.

6. Selecting seed varieties was more costly to begin with, but making the proper selecting has given me a greater tonnage yield.

7. One problem is learning soil analysis and then selecting products that enhance soil life (to overcome what chemicals have killed).

8. To meet nitrogen shortages, we use alfalfa, soybeans, and compost. Alfalfa and soybeans have long proven that they can add nitrogen to the soil.

9. To meet the ridicule from neighbors, I close my ears, concentrate on being positive, and even try to do a better job as a manager (attending to necessary details). Clear fields, relatively good yields, and lower costs tend to quiet up the critics. I am gaining more respect all the time from my peers.

10. Musk thistle has been a 15 year problem. I have hoed and scythed; each year they stayed the same or got worse. The last two years have seen some improvement, however. This may be due to less intensive grazing.

11. To hold soil in place, I have farmed on the contour and stopped using the moldboard plow. Now I have started using green manure crops and must again plow.

12. Weeds are a part of the eco-system. The goal should not be to totally eliminate them, but to bring them within tolerable limits. To control weeds, I plant rye with its allelopathic qualities, spade out thistles on pasture and hay ground, undertake timely tillage, and delay planting to permit first cultivating out one or two crops of weeds.

13. My fertility enhancing program includes attention to tilling in sweet clover at an optimum growth stage, tilling in of crop residues, adding soil conditioners and live bacteria, including more legumes in rotations, timely applications of manure, fallowing, and overall rebuilding and nurturing of the biological network. For six years, progress was limited. In the seventh year, however, radical and remarkable changes have taken place.

14. After having lived the "easy life" with chemicals, it's hard to make yourself go back to 18 hour days of cultivating, hoeing, and dragging. But it's well worth it. I use a Melroe Wiretine Drag on corn before the corn breaks through--which is a great help. I also use a rotary hoe.

15. I've been using alfalfa to help control weeds and supply nitrogen. The time for intensive management is limited in some times of the year.

16. To control grass in row crops, I plant a little later and use either a harrow or rotary hoe. With corn, I am fairly successful, but with soybeans I have only limited success.

17. Producing enough nitrogen to meet crop needs is a continuing problem. I'm trying to raise more soybeans and hay.

18. To meet the lack of information, I talk with other farmers interested in this type of farming. The university provides misinformation; you almost have to do the opposite.

19. To control weeds, I use the rotary hoe and undertake timely cultivation.

Northeast

20. Conservation and good land stewardship efforts are negated by others engaged in poisonous chemical farming. No solution is in sight. The whole attitude of America must change first. Presently, the soil is regarded by 99% of its "caretakers" as a medium to hold

chemicals to meet yield goal targets (e.g., 60 bu./acre wheat, 200 bu./acre corn).

21. My crop doesn't grow as tall as my neighbors think theirs is. They think there is no loss if their livestock graze it.

22. To overcome the flow of sprays onto my land, I ask my neighbors to read their spray labels and be careful.

23. To maintain a rotation cycle is hard. We have to stay with more alfalfa and fallow.

24. Financing for regenerative farming is a problem.

25. Bindweed has been a problem. Summer fallowing and sunflowers seem to help in setting it back.

26. It is difficult to find organic inputs. Industrial fertilizer companies claim and advertise organic products, but when you really check, you find that they do use chemicals (maybe not much, but they do).

27. I compost all my manure, and am perhaps 75% successful in meeting nitrogen needs. To hire a compost turner got to be expensive: $1,000 per year, including the bacteria I sprayed on the manure windrow to aid decomposition. Now I let the manure rot down and spread it on grain stubble. The only problem with compost is that I can't get enough of it. It's great!

28. Organic soil amendments are expensive and a lot don't work. I have tried a few and have settled on adjuvant (2 qt./acre) and liquid bacteria (1/10 gal./acre) at costs of $4.30 and $7.85/acre, respectively.

Selected central and western counties

29. In trying to overcome the lack of up-to-date information on regenerative agriculture, I have subscribed to several organic farm publications, e.g., "New Farm", organic gardening magazines, and publications from the Rodale Institute. These publications are helpful; they tell about individuals and how they have succeeded in organic farming. The methods have been tried and tested in practical ways by farmers around the world like me. The proof is in the pudding! It works!

30. Finding organic markets took time. But I became "certified organic" with FVO and have had quite good success in selling to MDI.

31. Not relying on chemical weed supplies forces you to be much more careful how you till and in the timing of planting and cultivation; an error of a few days can make a big difference.

32. Livestock must be included on a regenerative farm--to use crop residues and supply manure for compost.

33. We plow down sweet clover in our summer fallow. In some places, the sweet clover doesn't grow. Where sweet clover is thick, we have to be careful not to bury it so that air can't get to it. If air is trapped out, the sweet clover turns to formaldehyde and kills the soil. We use an offset disc that works well, but some of our sand hills are subject to wind erosion.

34. When we seed wheat and oats on fallow ground, we use a trace mineral pelleted as fertilizer. We have used Chilian Nitrate for nitrogen and a Colean Potash mined natural. This is put in the drill row through the fertilizer attachment on the drill at 100 lb./acre. If we don't get good moisture to activate and dissolve the pellets, we don't get the response in plant growth or weed control that we would like to have.

ANNEX 16

REPORTS IN THE LITERATURE
PROBLEMS/DISADVANTAGES ASSOCIATED WITH SUSTAINABLE AGRICULTURE

- Baker and Smith (1987) indicate more than 35% of their surveyed organic farmers in New York to report each of the following kinds of problems to be associated with regenerative production (in decreasing order of importance): weed management, insufficient time for farm work, marketing problems, low prices, and lack of appropriate tools;

- Blobaum (1984) reports weed control, higher labor requirements, lack of special markets, and problems relating to social pressure as main disadvantages of regenerative practices in his study of midwestern farmers;

- Lockeretz and Madden (1987) indicate at least 20% of the midwestern farmers in their survey to report as one of three leading disadvantages in 1987 the following (in decreasing order of importance): hard to find organic markets, weed problems worse, greater managerial expertise required, hard to get information, and requires more labor;

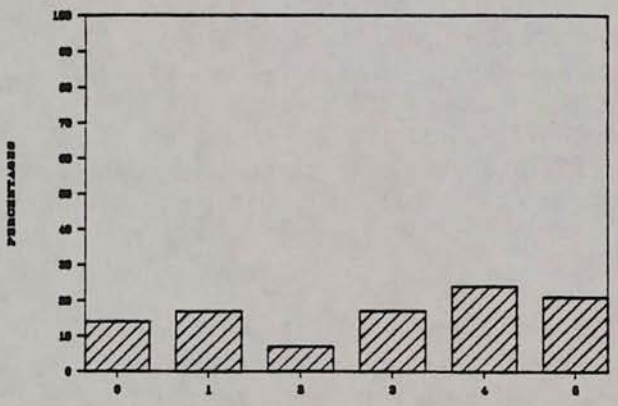
- Lockeretz, et al. (1981) and Wernick and Lockeretz (1977) report the four most frequently mentioned disadvantages of organic farming by their surveyed midwestern farmers as weed problems, difficulty in finding markets for organic products, lack of up-to-date information, and a low opinion of organic farming on the part of others; and

- Madden (1987) reports organic farmers in a multi-state survey to indicate concern over the following as most important in explaining why farmers avoid adopting "organic methods of farming": expected insect damage, difficulties in weed control, and a lack of reliable information on organic farming.

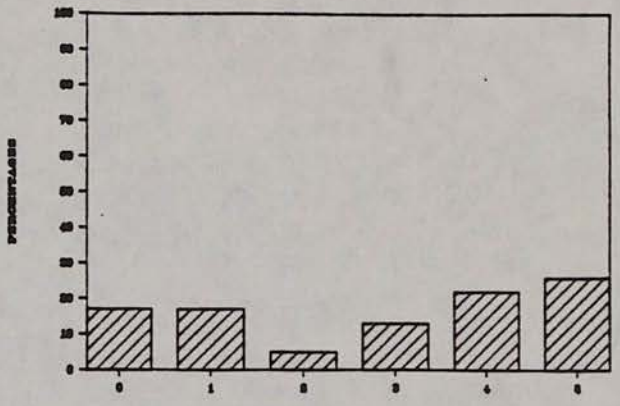
ANNEX 17

FREQUENCY DISTRIBUTIONS OF SOUTH DAKOTA REGENERATIVE FARMER RESPONSES TO POSSIBLE PROBLEMS WITH REGENERATIVE FARMING PRACTICES

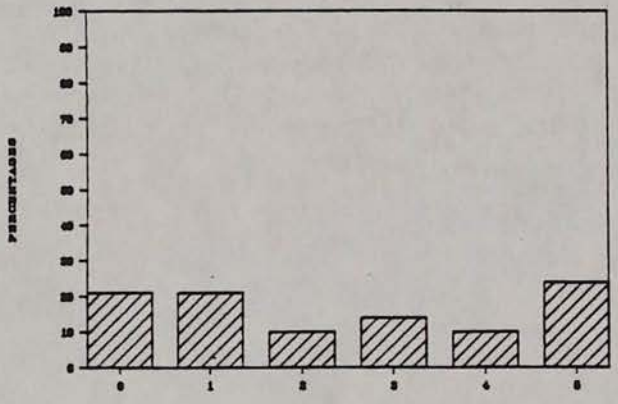
CONTINUING PROBLEM

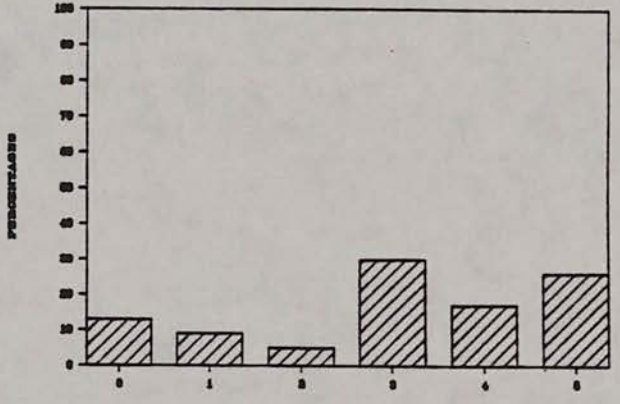


TRANSITION PROBLEM

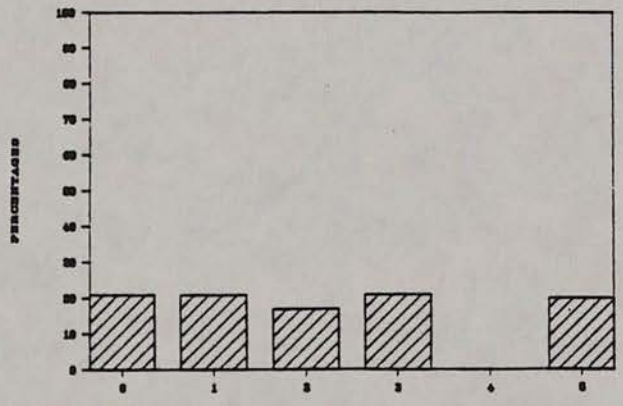


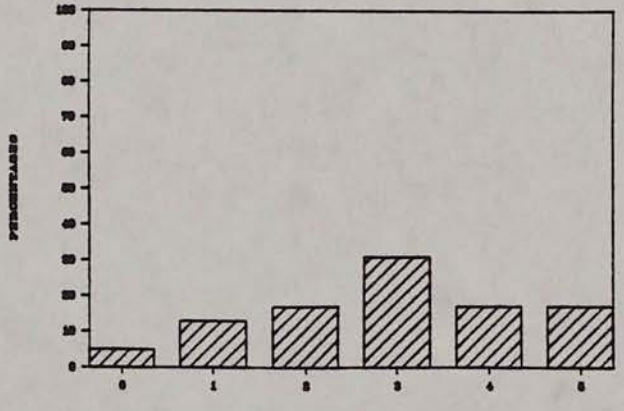
Possible Problem 1. Difficult to find organic market outlets.



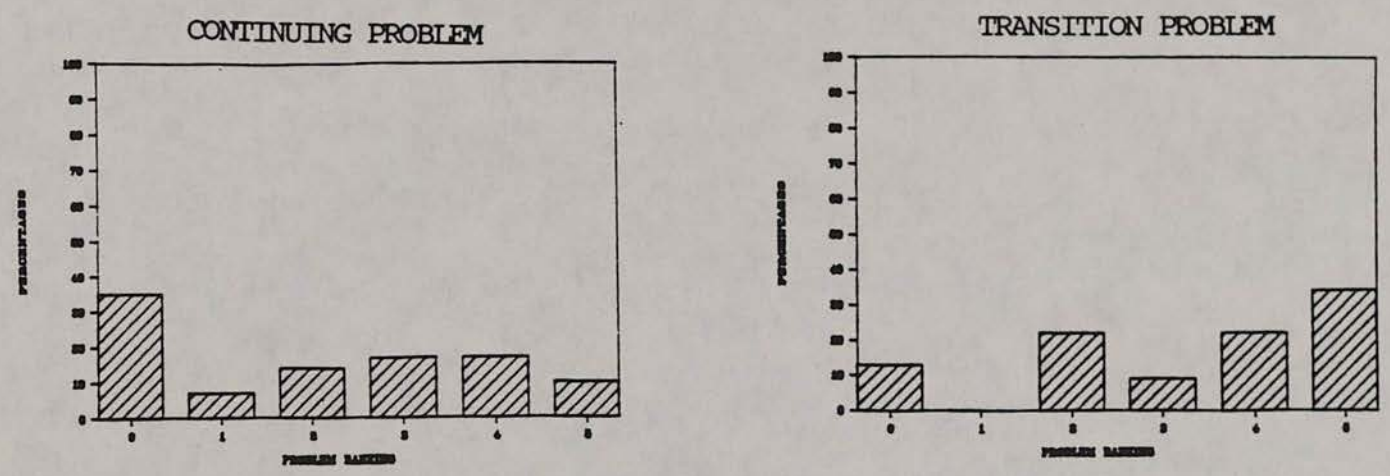


Possible Problem 2. Lack of up-to-date and accurate information.

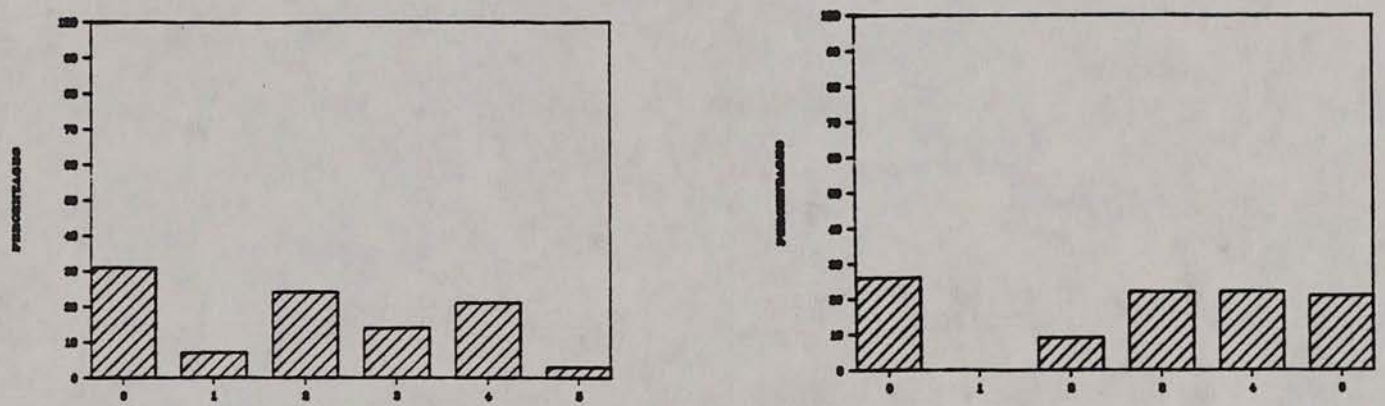




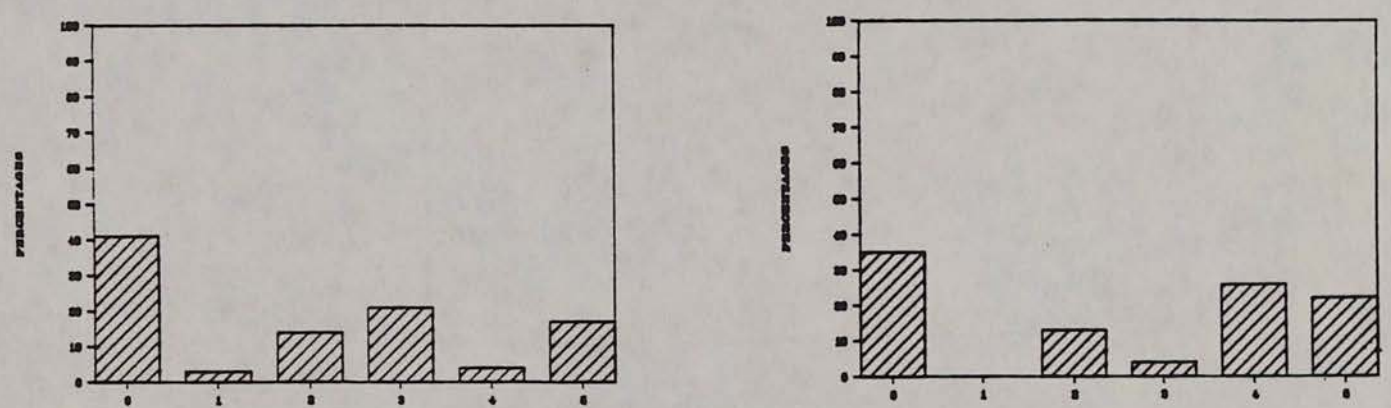
Possible Problem 3. Personal ridicule from neighbors.



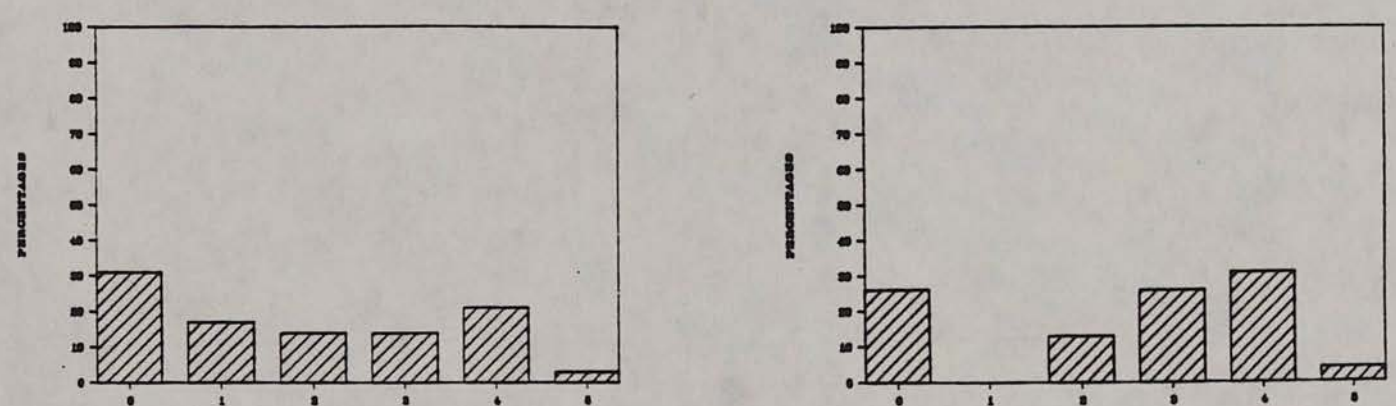
Possible Problem 4. Increased weed problems.



Possible Problem 5. Crops experience nitrogen shortages.

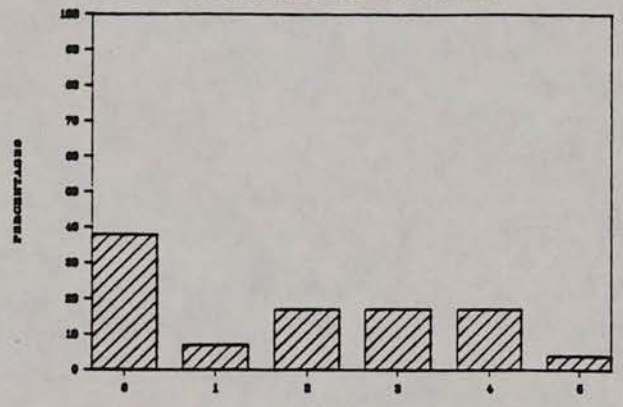


Possible Problem 6. Costly organic fertilizer and soil amendments.

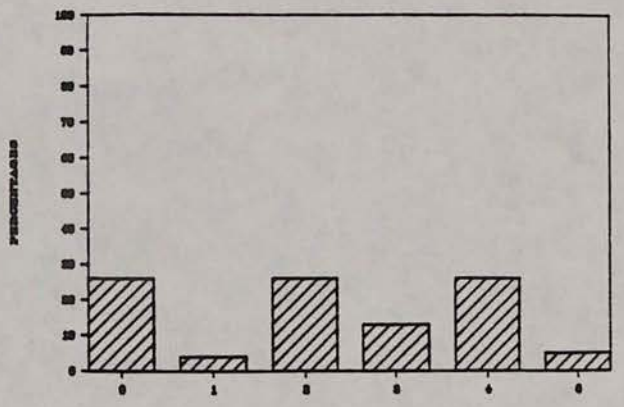


Possible Problem 7. Added requirements for management.

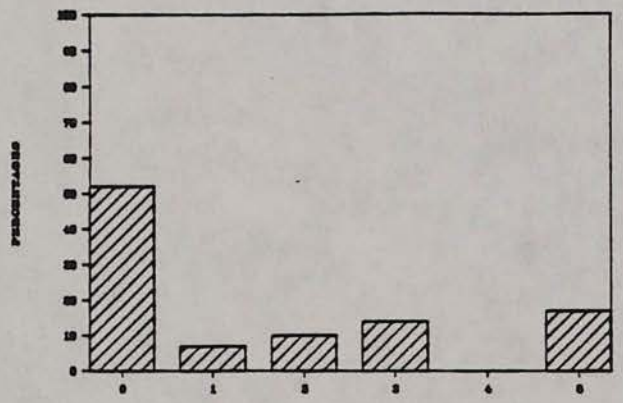
CONTINUING PROBLEM

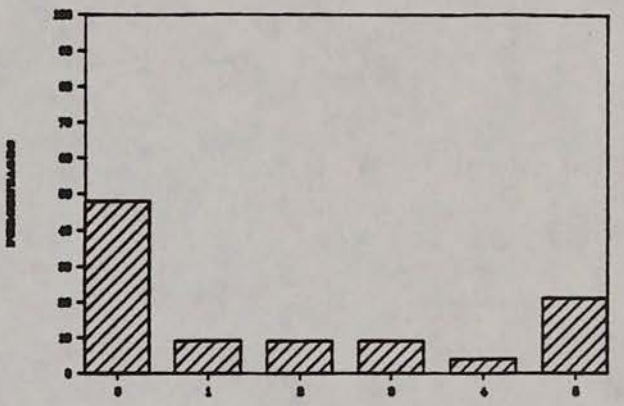


TRANSITION PROBLEM

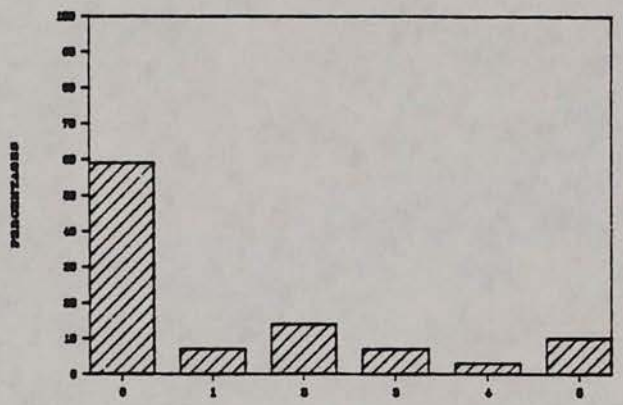


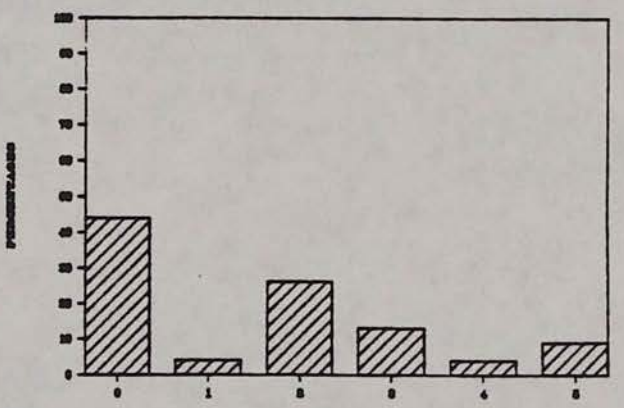
Possible Problem 8. Inadequate organic waste products.



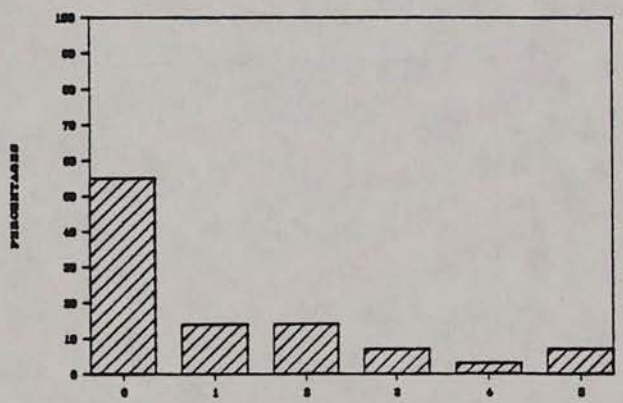


Possible Problem 9. Forced reduced base acreage in Federal farm program.



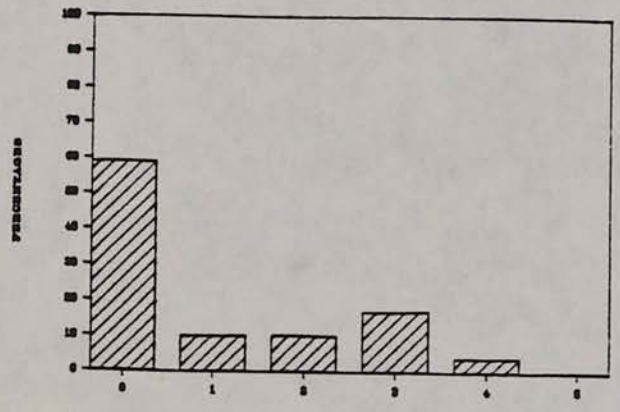


Possible Problem 10. Creditors reluctant to grant loans.

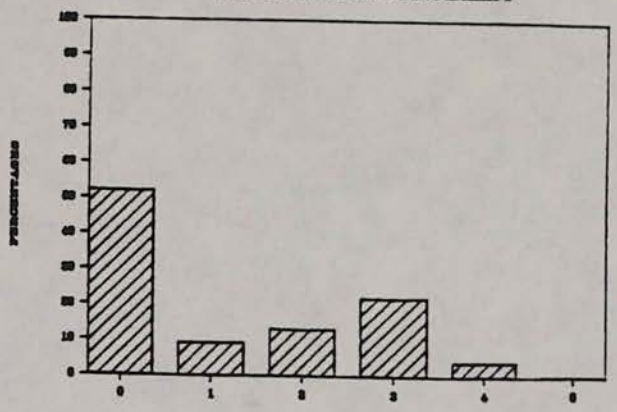


Possible Problem 11. Forced to have less farmland in high valued crops.

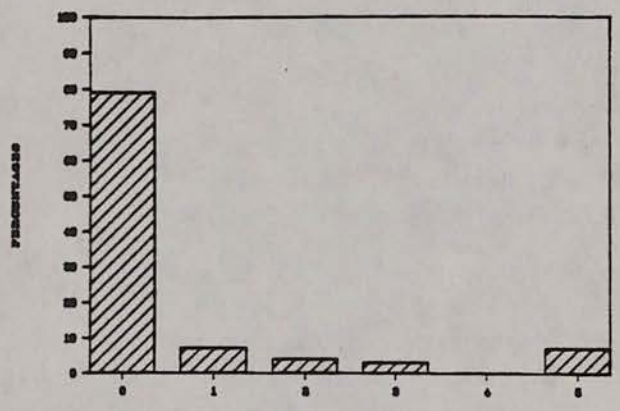
CONTINUING PROBLEM

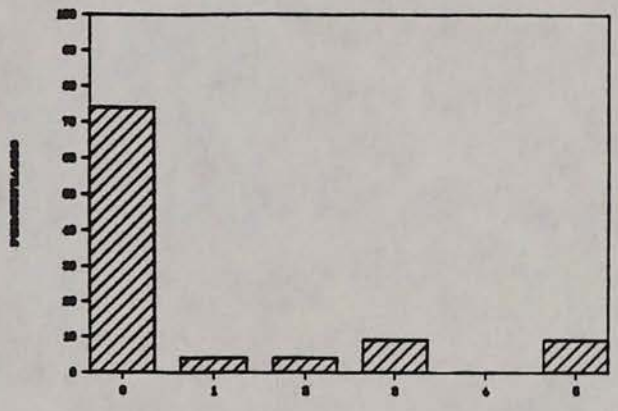


TRANSITION PROBLEM

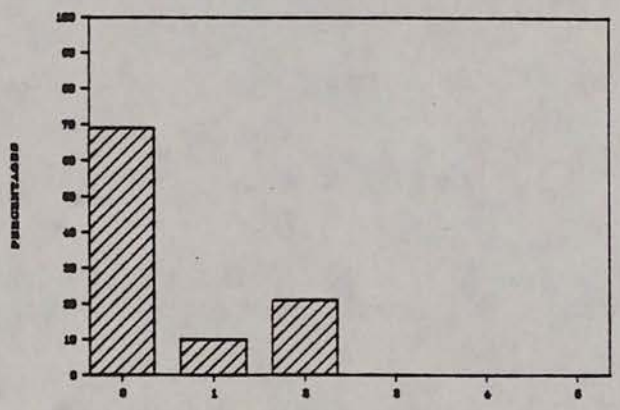


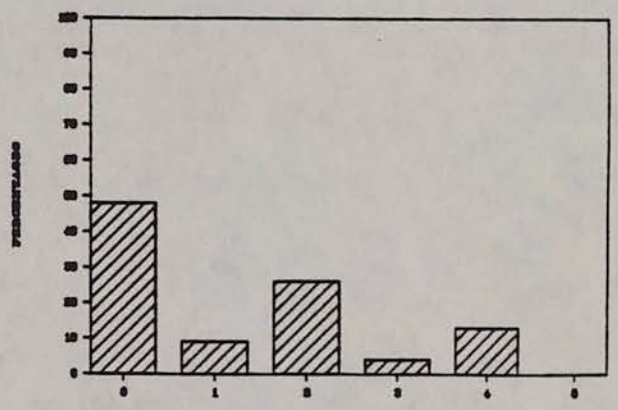
Possible Problem 12. A lack of pest resistant crop varieties.



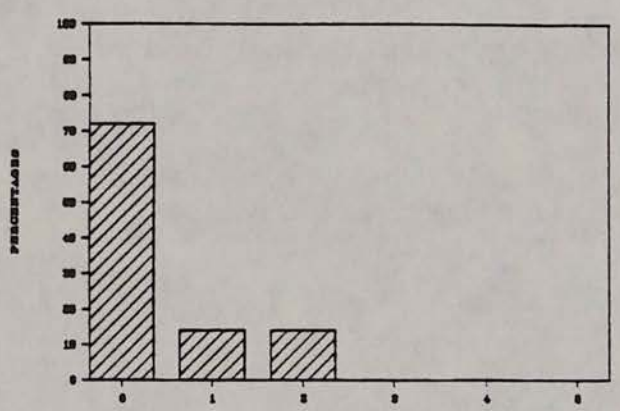


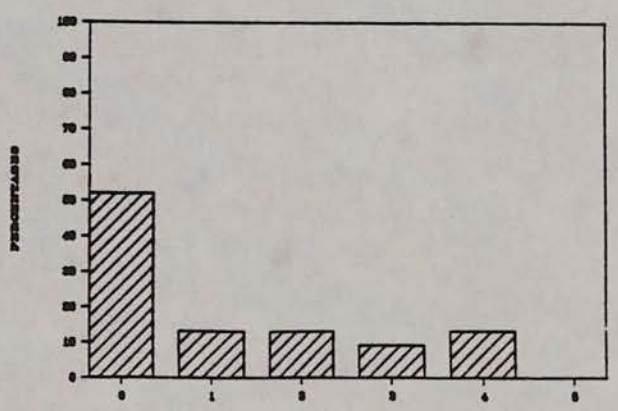
Possible Problem 13. Forced to be a livestock farmer.





Possible Problem 14. Increased insect problems.





Possible Problem 15. Increased disease problems.

ANNEX 18

REASONS FOR CONTINUING WITH REGENERATIVE FARMING

REGENERATIVE AGRICULTURE SURVEY RESPONDENTS, BY REGION

Southeast

1. If I were to use chemicals and produce poisoned food, I feel I would be hurting/killing my fellow men and stealing from future generations. I don't want to be part of a system that makes the water and air on our wonderful earth so poisoned we can't even drink/breath it.

2. Regenerative farming works.

3. I feel regenerative farming is more profitable. It is easy and enjoyable to practice and the risks (through enterprise diversification) are less than with conventional practices.

4. Regenerative farming is the only way that makes any sense to me.

5. I intend to continue with regenerative farming because of the moral commitment I have to protect the environment and produce a chemical-free food supply.

6. I plan to continue with regenerative farming because of land stewardship and higher profitability with less inputs.

7. Conventional farming contaminates the underground water supply and leaves chemical residues in our food supply.

8. I am responsible to the world and the next generation for what I am doing today.

9. Why not? The chemical culture of modern agriculture is heading down a dead-end street. To go with the flow of mother nature has to be the answer.

10. It is mandatory for the survival of the entire food chain.

11. Chemicals are dangerous.

12. Because of environmental concerns, synthetic chemical inputs are going to become more scarce and hence more expensive. It is also safer not to have to use dangerous chemicals.

13. Due to hazardous and toxic build up in our soil, I feel all farmers are going to have to move away from conventional practices. We are going to see more and more legislation against "it".

Northeast

14. I worry about what the Bible says about taking care of the land. I worry about the water, air, and food. Don't you care just a little too?

15. I believe that if farming continues as it has been going, we will eventually poison ourselves.

16. I have been commanded to care for God's creation and preserve the earth for future generations of God's people.

17. I like regenerative farming!

18. I plan to continue with regenerative farming because it works. I almost believe that, if I can get my soil in perfect balance, weeds won't grow. Don't laugh. The only reason weeds grow is to put soil back in balance. But then the Bible says it's because of man's sin. All life comes from the soil. We must stop treating our soil like dirt. Time is running out. I hope it's not too late.

Selected central and western counties

19. Regenerative farming works! It is sensible! It promotes life in the soil. It's healthy. How can conventional farming succeed when it is based on chemicals which destroy life in the soil, damage human and animal health, and destroy the environment. There is a cause for every effect. Why spend so much time feeding the plant when good healthy soil does it more effectively and profitably?

20. I find great value in the multitude of game birds, deer, rabbits, and other wild animals on my farm. My animals are healthy and my fields are as good as any. I derive satisfaction from seeing ground turn from being hard as a rock to being mellow. I am still experimenting with different tillage practices and plant timing. The progress is encouraging, especially the bottom line. I have maintained a positive cash flow in five of the last seven years of farming.

21. I plan to continue to be a good steward of the earth.

22. We feel that in the future the use of chemicals will kill the soil, or the producer will have to pay a penalty for pollution.

23. I like the lower costs and reduced risks with regenerative farming, also the long-term benefits to the land.