A Pilot Study of Farmers’ Perceptions of Soil Conservation in the Gunnedah Shire, New South Wales

Key Words: soil degradation, farmer's perceptions

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Abstract: One hundred and fifty farmers in the Gunnedah area were surveyed to obtain information about perceptions of soil loss problems, soil management practices and a number of economic and social factors. Cluster analysis was then used to group the sample according to the severity of perceived soil loss problems and other characteristics. Perceptions of soil loss problems were found to be related to enterprise mix and soil types and use of land management services were found to be consistent with the perceived severity of problems. Interestingly, membership of Landcare groups was found to be independent of the severity of perceived soil loss.

INTRODUCTION

The purpose of this paper is to report the results of a pilot survey of farmer's attitudes to soil conservation that was undertaken in May of 1992. The survey was undertaken to assist in the formulation of hypotheses for a much larger study planned for 1994. It was hoped that the 1994 study would yield specific information on (a) farmers perceptions of soil degradation on their own farms, (b) whether farmers are likely to view such degradation as a 'problem' and (c) how specific characteristics of farmers and their farms were likely to influence perceptions and reactions to soil loss. Such information could lead to improved efficiency in government policies designed to deal with soil conservation through better understanding of factors influencing soil conservation behaviour.

DESIGN OF THE SURVEY AND QUESTIONNAIRE

Survey area

The focus of the study was on how farmers perceive soil loss rather than on whether their farms actually have soil loss problems. Thus a survey area was needed where the extent of existing soil loss was already well researched and, since the study was to be 'pilot' in nature, the area needed to have a range of soil types and cropping and grazing activities. The Gunnedah area in northern New South Wales (NSW) met these requirements well. It is part of the Liverpool Plains on the northern slopes of NSW.

The Gunnedah area had fallen within Hamilton's 1970 study of sheet erosion in the NSW wheat belt. Hamilton obtained data on soil loss from 1955 to 1968 and found that losses in productivity from sheet erosion were both immediate and significant. Extensive analysis of soil loss and its relationship to various tillage techniques and alternative land uses has been undertaken at the state Gunnedah Research Station (Junor, 1979). Also, the NSW Soil Conservation Service conducted a state-wide survey of land degradation in 1987-88 and the Gunnedah area was one of those with severe sheet and rill erosion problems (Graham, 1988). The Universal Soil Loss Equation was applied to the Gunnedah area in the late 1980s and soil loss rates were estimated to vary from 25 tonnes per hectare for conventionally cropped susceptible soils to 5 tonnes per hectare for less susceptible soils under zero tillage methods (Cameron and Green, 1990).

The Gunnedah area is primarily a crop growing area. It has rainfall of around 620 mm which mainly falls between October and March and can be of high intensity. The area has hot summers and mild winters with some frosts. The soils vary from heavy black soils on the flood plains to red-brown eaux, euchrozem soils (brigalow scrub) and sandy loams in the undulating and hilly areas. The black soils have a high water storage capacity which is beneficial to winter crops and are reasonably deep and fertile. They are also highly
erodible (Cameron and Green, 1990). Junor (1979) classifies earthy sands, black and red-brown earths in the Gunnedah area as highly erodible, the brown clays and red earths as moderately erodible and the euchroems and krasnozems as slightly erodible.

The principal agricultural enterprises in the region are wheat, sheep, cattle and some summer crops. With the development of machinery suitable for the heavier black soils in the mid 1960s, wheat production expanded rapidly and, around the same period, sheep declined in importance relative to cattle. Summer crops have become more important since the early 1970s with cotton continuing to expand on both irrigated and non-irrigated mainly black soils.

Trends in tillage techniques have favoured better soil management. Stubble retention began in the 1960s with current practices including stubble mulching on the soil surface, stubble roughly ploughed in and use of chemicals for weed control. Strip cropping also began in the 1960s. This involves growing crops in rotation in alternative strips across the slope of the land. Ploughing "follows the contour line with strips 100 to 200 metres wide and alternating between fallow, stubble and growing crop (Cameron and Green, 1990, Junor, 1979).

The questionnaire

The questionnaire was written so that most answers were yes or no or in percentages and was kept reasonably short to encourage producers to respond. It was sent to 150 farmers of whom approximately half were in the district with predominantly black soils and the other half were from districts with predominantly red soils. The selection was made to allow comparisons of responses of farmers from the two main soil types, red and black.

The goal of the questions was to find relationships between farmer and farm attributes and whether farmers believed they had a 'problem' with soil loss. Thus information was sought on farm attributes such as enterprise mix and technology, farm size, soil type and depth and on farmer characteristics such as age, education, contact with relevant information sources, participation in Landcare and perceptions of the nature and importance of the relationship between soil depth and farm productivity.

The questionnaire was divided into four questions covering (1) farm and farmer attributes, (2) nature of soil degradation on the respondents farm, (3) perceptions of soil conservation and (4) some policy questions. A summary of the questions is reproduced below.
Question 1
(1) Area of land to nearest 100 ha
(2) Income proportion from: cattle, sheep, grain, off-farm, hay, other (%)
(3) Proportion of land under cultivation (%)
(4) Tillage method: traditional (stubble burnt), no/minimum till, till + chemical weed control, stubble ploughed in, stubble mulch
(5) Primary soil types (%): black clay, red clay, red/brown loam, grey clay, other
(6) Information services used: radio, newspaper, television, other producers, Soil Conservation Service, Landcare group (member or non-member), private consultant, Department of Agriculture, farm magazines, chemical reseller, other
(7) Age group: <30, 30-40, 40-50, 50-60, 60-70, 70+ years
(8) Education level: primary school, secondary school, agricultural college, university, other

Question 2
(1) Is the yield/soil depth relationship true in general? (YES/NO)
(2) Is soil removal reducing your production, or will it reduce it in future? Short term (< 3 years), medium term (3-6 years), long term (6-10 years) (YES/NO/UNSURE for each)
(3) If yes, on what proportion of your land? (%)
(4) Do other soil characteristics influence productivity more that soil-depth? Structure, nutrients, salinity, plant density, acidity, other
(5) What would be the magnitude of your soil loss problem on your main soil types? severe (well worth fixing), moderate (worth fixing, problem developing), small (not a problem at present), or future (problem may develop)

Question 3
(1) Do you believe soil conservation on your land is a good investment? Short term, medium term, long term (YES/NO/UNSURE for each)
(2) Do you believe that without soil conservation your production levels will fall? Short term, medium term, long term (YES/NO/UNSURE for each)
(3) Will soil conservation increase the asset value of your land in the long term? A lot (>30%), significantly (20-30%), moderately (10-20%), not much (1-10%), very little (0-1%)

Question 4
(1) Choice between extension and research
(2) Choice between tax rebates or cheaper soil conservation services
(3) Choice between soil conservation and other capital works
In question 2 (1) respondents were provided with a diagram with soil depth on the horizontal axis and agricultural yield on the vertical axis and were asked to mark their yield/soil depth position on the diagram similar to Figure 1. In question 4 the intention was to find and rank farmers' preferences for different government policies.

![Figure 1: The Yield Curve.](image)

Note that soil erosion has no effect on agricultural yield until a critical depth of soil is reached. This is at x.

**RESULTS**

**Survey responses**

Of the 150 surveys sent out to farmers, 51 were returned 'useable' condition. From the standpoint of conducting a pilot study we were concerned with two primary aspects of the responses. First, whether the questions in the survey were unambiguous and hence would be likely to yield consistent responses across the sample. Second, whether the questions had actually succeeded in 'capturing' the information that we sought.

Question 2 (1), concerning farmers interpretations of the yield/soil depth relationship was interpreted in a number of ways and responses could not be used in the manner that was originally intended. It appears that while the yield/soil-depth diagram may be clear to scientists, it is either overly simplified or too complex for farmers. Respondents were expected to either position their farms on the flat part of the yield/soil-depth curve or on the convex part. The responses received were not consistently related to other answers to the
questionnaire. Despite this setback, the survey was a success in terms of our second goal of 'capturing' desired specific information.

As individuals, farmers appear to have well formed and consistent views on soil conservation. The two thirds of farmers surveyed who did not respond may have been different in this regard and a point that emerged from the whole survey process was that telephone follow-up of non-respondents may have been worthwhile.

**Question 1**

Ninety per cent of the respondents grew grain with the proportion of income from grain ranging from 5 to 100 per cent. Cattle enterprises were the next most common enterprise and were undertaken by 70 per cent of respondents. Just over a third of respondents obtained income from off the farm and just over 20 per cent obtained income from sheep. The highest proportion of income obtained from sheep was 55 per cent.

Only three respondents used traditional tillage with burning of the crop stubble and most respondents used more than one of the five tillage options outlined in the questionnaire. Over 70 per cent of respondents used a combination of chemicals and some tillage. (Usually a herbicide is used first to kill off weed growth and then the soil is tilled once or twice depending on whether a fine seed bed is required for the particular crop.)

The most popular information services were newspapers, radio, Department of Agriculture, chemical resellers, farm magazines and other farmers. Fifty per cent used these services. The Department of Agriculture was the most widely used information service, after newspapers and radio reports.

Over eighty five per cent of respondents were in the 30 to 60 year age group with the most popular group being 40-50 years (36%), followed by the 30-40 years group (26%) and then by the 50-60 years group (24%). All respondents answered the optional educational level question with 75 per cent indicating secondary school as the highest level reached.

**Question 2**

In the first part of question 2 it was asked whether farmers believed that soil loss would reduce crop yield and 49 out of the 51 respondents answered in the affirmative. In the second part of the question the extent of soil loss and whether it constitutes a problem was examined. Almost half of the respondents believed soil loss would reduce long term production. Around 65 per cent indicated that they had a severe or moderate soil loss problem. The majority of respondents indicated that they believed that soil nutrients and soil structure were more important considerations than soil loss.
Question 3

Question 3 was used to ask about the value of soil conservation as an investment. That is, whether returns from soil conservation would outweigh costs and whether it would increase the value of land. The responses here were somewhat inconsistent. Twenty-six respondents indicated that short term production would fall without soil conservation but only 15 said erosion would be likely to reduce their short term production. A similar inconsistency emerged for the medium and long terms where more respondents said that production would fall without soil conservation than said that erosion would reduce production. The reasons for this inconsistency are unclear however a possible explanation is that farmers have taken 'soil conservation' to mean more than erosion control.

Around 65 per cent of respondents believed that long term production would fall without soil conservation and saw soil conservation as a good long term investment. There was no indication that any of the respondents who perceived soil loss as reducing productivity believed that conservation was not warranted as an investment. However around 30 per cent of respondents indicated that they were uncertain about the long term effects of soil loss on productivity and about 25 per cent indicated uncertainty about the investment potential of soil conservation.

Eighty per cent of respondents believed that soil conservation would increase the value of farm land by 10 per cent or more in the long term.

Question 4

Question 4 was directed at finding out whether farmers would prefer to have more extension or more research on soil conservation and whether tax rebates would be preferred to cheaper soil services. Sixty per cent of respondents preferred more research to more extension services. Fifty-five per cent of respondents preferred cheaper soil works to tax rebates for soil conservation. This may have been influenced by currently low farm incomes that may mean that many farmers were not paying significant amounts of tax.

Sixty-five per cent of respondents indicated that they would prefer to undertake soil conservation works in preference to other capital works such as fences and road building. This reflects the high number of respondents that indicated that soil conservation would be a worthwhile long term investment.

Cluster analysis

Cluster analysis was undertaken to identify any relationships between the variables. For example, whether there was a relationship between the amount of soil loss on a particular farm and the value placed on soil conservation by the farmer. Cluster analysis is generally directed towards four goals:
development of a classification
investigation of schemes for grouping data sets
hypothesis generation through data exploration
hypothesis testing (Aldenderfer and Blashfield, 1990)

The statistical package SPSSx Version 4.0 was used to undertake the analysis on the University of New England mainframe computer using unweighted data.

Categorisation requires the grouping of things that are similar. Problems arise concerning the appropriateness of different expressions of similarity because the suitability of similarity measures varies with circumstances. The concept of metrics is used in estimation of similarity. It is based on measuring the metric distance between points in co-ordinate space and a measure based on squared Euclidean distance was used in this study.

Selection of which variables to cluster was initially based on results from previous studies. For example, general results have emerged from studies undertaken in 1991 by the Australian Bureau of Agricultural and Resource Economics and Rural Development Centre (Campbell and Junor, 1992) that farmers who were members of Landcare groups were more committed to land conservation, more likely to have implemented land conservation works and were more active in obtaining technical land management information. These results and other related questions were tested in the analysis reported below. The data was clustered into two groups, A with 20 cases and B with 31 cases. The average land area for farms in A was 1194 hectares with a range of 300 to 3770 hectares and for farms in B was 910 hectares with a range of 50 to 5000 hectares. The principal differences between farmers in the two cluster groups are outlined in table 1.

Group A farmers were more likely to believe they had a severe or moderate soil loss problem. This group was also more positive about the short term returns to soil conservation than the other group, but were similar in their opinions on it's medium and long term investment value. The average farmer in group A earned 87 per cent of income from grain production and about six per cent from cattle enterprises. Also on average 87 per cent of the farm was black soil. The farmers in this group were more likely to use a wide range of land management information services such as the Soil Conservation Service, other producers, private consultants, television, Department of Agriculture and chemical resellers. Both groups had the same likelihood of being a member of a Landcare group, 35 per cent.
Table 1: Summary of Cluster Characteristics

<table>
<thead>
<tr>
<th>Farmer A more likely to:</th>
<th>Farmer B more likely to:</th>
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<tbody>
<tr>
<td>believe they have a severe or moderate soil loss problem</td>
<td>believe they have a small soil loss problem</td>
</tr>
<tr>
<td>believe soil loss will reduce production in the short run</td>
<td>be unsure about the effect of soil loss on production in the short run</td>
</tr>
<tr>
<td>cultivate 90% of the farm</td>
<td>cultivate 40% of the farm</td>
</tr>
<tr>
<td>produce grain</td>
<td>farm mixed enterprises</td>
</tr>
<tr>
<td>own a black soil property</td>
<td>own a farm with red clay or red/brown loam soil</td>
</tr>
<tr>
<td>be aged between 40 and 60 years</td>
<td>be aged between 30 and 50 years</td>
</tr>
<tr>
<td>use more land management services</td>
<td>use less land management services</td>
</tr>
<tr>
<td>use no till, herbicides and tillage, and stubble mulch techniques</td>
<td>plough stubble in</td>
</tr>
<tr>
<td>believe soil conservation is a good short term investment</td>
<td>be unsure about the short term investment value of soil conservation</td>
</tr>
<tr>
<td>believe soil structure and nutrients are more influential on production than erosion</td>
<td></td>
</tr>
<tr>
<td>believe soil conservation will increase land value by more than 30%</td>
<td>believe soil conservation will increase land value by 1 to 10%</td>
</tr>
<tr>
<td>prefer more research to more extension services</td>
<td></td>
</tr>
</tbody>
</table>
Farmers in A tended to be younger than those in B however the distribution of these age groups is unusual possibly due to the small sample size (see Table 2). Note that some farmers put the age of their spouse in their answers as well as their own. This is a problem with surveys of this type because some farms have only one manager while others have joint management.

Farmers in B were more likely to believe they had only a small soil loss problem. Their income sources and land types were less uniform than farmers in group A. On average farmers in B earned 30 per cent of income from grain, 40 per cent from cattle, 16 per cent from off farm sources and nine per cent from sheep. They were thus more likely to have mixed enterprises. The soil types were more mixed with black soil 28 per cent, red/brown loam 33 per cent, red clay 22 per cent and other nine per cent. The only type of information service used more by farmers in B was newspapers and advice from Landcare on a non-member basis.

Table 2: Age Groups

<table>
<thead>
<tr>
<th>Age group</th>
<th>Group A</th>
<th>Group B</th>
</tr>
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<tbody>
<tr>
<td>&lt;30</td>
<td>15%</td>
<td>0%</td>
</tr>
<tr>
<td>30-40</td>
<td>5%</td>
<td>39%</td>
</tr>
<tr>
<td>40-50</td>
<td>40%</td>
<td>32%</td>
</tr>
<tr>
<td>50-60</td>
<td>30%</td>
<td>19%</td>
</tr>
<tr>
<td>60-70</td>
<td>10%</td>
<td>6%</td>
</tr>
<tr>
<td>70+</td>
<td>0%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Farmers in A had a 30 per cent probability of perceiving themselves as having a severe soil loss problem and 55 per cent probability of a moderate soil loss problem, compared to 6 per cent and 42 per cent respectively for farmers in B who had a 52 per cent chance of perceiving themselves as having only a small soil erosion problem. Farmers in A were more likely to say that soil structure and nutrients influence production levels more than soil depth. Responses for salinity, acidity and plant density were the same for A and B.
Cluster A farmers were more likely to believe that soil loss reduces production in the short term (40 per cent versus 23 per cent in cluster B). Both groups had similar responses for medium and long term production losses with 20 per cent saying it would reduce production in the medium term and 50 per cent that it would reduce production in the long term. Farmers in A appear to be more concerned about soil loss in the short term than farmers in B.

Farmers in A were more positive about the returns to soil conservation in the short term than farmers in B however both groups took a similar view of returns in the medium and long terms. About half of each group saw soil conservation as a good medium term investment and about 70 per cent saw it as a good long term investment. Around 30 per cent of each group were uncertain about whether medium and long term returns on soil conservation would make it worthwhile.

Farmers in A were more positive about the effect of soil conservation on asset value with 90 per cent believing it would increase value by greater than 10 per cent and 35 per cent believing it would increase values by more than 30 per cent. This compared to farmers in B where only 16 per cent believed it would increase values by more than 30 per cent.

Landcare membership between the two groups was similar despite farmers in A perceiving that they had a more severe soil loss problem than farmers in B. This seems to indicate that both groups place equal value on participation in (and presumably advice from) Landcare whether they have soil erosion problems or not. The two groups were equally likely to use radio and farm magazines as information sources however farmers in A were more likely to use chemical resellers for advice. This is probably because grain farmers have more contact with chemical resellers since they use more pesticides, herbicides and fertilisers than mixed farmers.

There was no significant difference between the two clusters in response to the choice between tax rebates and cheaper services or between soil conservation and capital works.

**DISCUSSION AND CONCLUSIONS**

Most of the results of the survey were broadly consistent with expectations. Farmers' perceptions of their soil situation were conditional on their enterprise mixes and soil types and their tillage and use of land management services were consistent with their perceived soil loss situation. Perceptions of returns from specific land care investments were, for the most part, consistent with perceptions of the severity of problems, at least in the short run.
Expectations about the effect of soil conservation on land asset values were also consistent with interest expressed in investment in soil conservation and with perceptions about the severity of soil loss problems. The results reflect that soil loss is likely to be a more serious financial problem for grain farmers than for mixed enterprise farmers and it seems likely that soil losses cause grain properties to lose value faster than mixed enterprise properties.

The results for the expected returns to soil conservation in the medium and long runs are less easily explained. Both groups saw soil conservation as being a good investment in the medium and long term. This seems inconsistent with the different views expressed by the two groups on both land asset appreciation and on perceptions of the severity of their soil loss problems. It is possible that the term 'soil conservation' was interpreted differently by the two groups.

It was initially surprising that membership in Landcare was similar in both groups given that grain farmers perceived themselves as having more severe soil loss problems. This may reflect the broader role played by Landcare in the community than simply as a provider of information for rectification of short term soil loss problems and is consistent with the similar attitudes towards medium and long term returns from investment in soil conservation held by the two groups (RDC, 1992).

It is clear that the study could have been improved in a number of ways. First, it seems likely that terms such as 'soil loss' and 'soil conservation' may be interpreted differently by farmers in different situations. Second, it is possible that the term 'investment' was interpreted differently by farmers in different circumstances. Finally, the major problem confronting the study was the size of the sample. While 51 respondents provides a sufficiently large sample for drawing conclusions about two representative groups, a larger sample would have allowed for more clusters and hence more specific descriptions of groups within the farming community.

REFERENCES


Cameron and Green (1990) Recovering ground: A case study approach to ecologically sustainable land management, Australian Conservation Foundation, Ch 2

