Evaluation of risk factors leading to soil destabilisation on the south coastal sandplain of Western Australia

R V R Gwynn
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Evaluation of Risk Factors Leading to Soil Destabilisation on the South Coastal Sandplain of Western Australia

R.V.R. Gvwnn
P.A. Findlater
J.R. Edwards

Resource Management Technical Report No.52
Disclaimer

The contents of this report were based on the best available information at the time of publication. It is based in part on various assumptions and predictions. Conditions may change over time and conclusions should be interpreted in the light of the latest information available.

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1. Introduction

The problems of wind erosion in part of the south coast of Western Australian sandplain area were described previously (Gorddard et al., 1981) with 7.3 per cent of cleared and 18.3 per cent of the cropped area showing evidence of sand blasting. Department of Agriculture trials have shown that the loss of the top four millimetres of top soil from pastured paddocks can reduce following crop yields by up to 20 per cent (Marsh and Carter, 1983). Animal production problems associated with wind erosion of soils have not been quantified, but a number of problems such as reduced carrying capacity and nutritional problems are seen as significant throughout the area. Farmer opinion suggests that high grazing pressures are a major contributing factor to wind erosion however Gorddard et al (1981) were unable to identify any empirical relationship between stocking rate, cropping practice and erosion risk.

Following two years of severe wind erosion in 1983 and 1984 a study, funded by the National Soil Conservation Programme, was carried out by the Western Australian Department of Agriculture to investigate the factors associated with wind erosion on farms near the south coast of Western Australia. (Figure 1.)

![Figure 1. THE SOUTHERN SANDPLAIN](image)

The study was carried out in two parts:

(i) A preliminary Survey: involved a mailed questionnaire sent to randomly selected farmers.
(ii) **Case/Control study**: farms selected from the preliminary survey as to whether they had erosion (cases), or not (controls) were investigated in more detail by means of an interview questionnaire.
2. Materials and Methods

2.1 Preliminary Survey

Questionnaires were mailed in late 1984 to 500 randomly selected farmers on the South Coast of Western Australia. The survey area was restricted to the area where erosion was known to have occurred and included parts of the following shires: Albany, Plantagenet, Gnowangerup, Jerrarnungup and Ravensthorpe. The sample was stratified by Shire and selected from the list of property owners as supplied by the Agriculture Protection Board. There were just over 2,000 farms registered in the survey area.

The questionnaire consisted of 20 questions and aimed to collect information on the problem of wind erosion as perceived by farmers and identify areas for a more detailed study (Appendix 1). The questionnaire was tested on five farmers before the final version was completed.

An explanatory letter and stamped return addressed envelope were sent with the questionnaire. After four weeks a reminder letter with a questionnaire and stamped return addressed envelope was sent to non-respondents.

The data from the questionnaire was coded for analysis using the Statistical Package for the Social Sciences (S.P.S.S.) computer package (Nie et al, 1975). Tables were analysed using a chi square ($X^2$) test.

only those tables with significant results or thought to be of relevance are included in the results.

2.2 Case/Control Study

Properties were selected from the preliminary survey on the basis of their response to the question “What was the area of your farm stripped bare by wind between January and June 1984”. They were classified into Controls (nil area affected) and Cases (greater than 80 hectares affected). The majority of cases had greater than 100 hectares affected.

The selected cases and control farms were then visited and an interview questionnaire completed (Appendix II). The questionnaires differed slightly for cases and controls, there being 96 questions in the case questionnaire and 91 in the control questionnaire.

The questionnaires were tested on two farmers before a final version was completed.

The distribution of cases and controls in the shires is shown in Table 2.1
Table 2.1 Number of cases and controls in each Shire

<table>
<thead>
<tr>
<th>Shire</th>
<th>Cases</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albany</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Plantagenet</td>
<td>23</td>
<td>17</td>
</tr>
<tr>
<td>Gnowangerup</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Ravensthorpe</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Jerramungup</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>43</td>
<td>43</td>
</tr>
</tbody>
</table>

The data from the questionnaires was analysed by analysis of variance, Pearson chi square ($X^2$) test, and relative and attributable risk. The means of other variables were visibly scanned. Only those variables showing significant differences are included in the results.
3. Results and Discussion

3.1 Preliminary Survey

Three hundred and seventy six (75.2 per cent) useable forms were returned. There was a small variation in level of response between shires ranging from 72.3 per cent in Jerramungup to 78.3 per cent in Plantagenet shire.

The mean area of the farms was 1,079 hectares with a mean of 929 hectares cleared in 1984.

In 1984 cropping was carried out on 86.2 per cent of the farms surveyed. The area cropped ranged from less than 49 hectares (22.1 per cent of respondents) to greater than 2,000 hectares (0.2 per cent of respondents). The mean cropped area was 288 hectares.

Sheep were run on 89.9 per cent of the farms with the flock size ranging from less than 99 (2.4 per cent of respondents) to greater than 20,000 (0.3 per cent of respondents). The mean flock size was 2,500.

Cattle were run on 40.4 per cent of farms with the herd size ranging from less than 29 (10.4 per cent of respondents) to greater than 500 (1.6 per cent of respondents). The mean herd size was 66.

Fifty-two per cent of the respondents reported not having any area stripped bare by wind in 1984. Those reporting having areas stripped bare by wind ranged from less than 49 hectares (98 farms or 26 per cent of respondents) to in excess of 750 hectares affected on 2 farms (0.5 per cent of respondents). The mean area blown bare for all farms was 43 hectares.

When asked to comment on the causes and prevention of wind erosion 220 (58.5 per cent) of the respondents replied, giving a total of 455 responses. A range of replies was given with individual respondents giving up to four perceived causes or preventative methods. A total of 28 perceived causes of wind erosion were listed; reduced rainfall (11.1 per cent of responses), severe wind (10.5 per cent of responses), timing of rainfall (9.6 per cent of responses), overgrazing (9.3 per cent of responses) and light soils (8 per cent of responses) were the major causes listed.

Table 3.1 gives a complete list of perceived causes.
Table 3.1 Number of responses to each perceived cause of wind erosion

<table>
<thead>
<tr>
<th>Perceived cause</th>
<th>No. of responses</th>
<th>percentage of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced rainfall</td>
<td>36</td>
<td>11.1</td>
</tr>
<tr>
<td>Severe wind</td>
<td>34</td>
<td>10.5</td>
</tr>
<tr>
<td>Timing of rain</td>
<td>31</td>
<td>9.6</td>
</tr>
<tr>
<td>Overgrazing</td>
<td>30</td>
<td>9.3</td>
</tr>
<tr>
<td>Light soil</td>
<td>26</td>
<td>8.0</td>
</tr>
<tr>
<td>Insufficient perennial grass</td>
<td>22</td>
<td>6.8</td>
</tr>
<tr>
<td>Sheep</td>
<td>20</td>
<td>6.2</td>
</tr>
<tr>
<td>Insufficient annual grass</td>
<td>19</td>
<td>5.9</td>
</tr>
<tr>
<td>Insufficient clover</td>
<td>14</td>
<td>4.3</td>
</tr>
<tr>
<td>Wind direction</td>
<td>14</td>
<td>4.3</td>
</tr>
<tr>
<td>Debts and finance</td>
<td>14</td>
<td>4.3</td>
</tr>
<tr>
<td>Overcropping</td>
<td>10</td>
<td>3.1</td>
</tr>
<tr>
<td>Excess capeweed</td>
<td>8</td>
<td>2.5</td>
</tr>
<tr>
<td>Disc ploughs</td>
<td>8</td>
<td>2.5</td>
</tr>
<tr>
<td>Insufficient shelter</td>
<td>6</td>
<td>1.9</td>
</tr>
<tr>
<td>Heavy soils</td>
<td>4</td>
<td>1.2</td>
</tr>
<tr>
<td>Stubble burning</td>
<td>4</td>
<td>1.2</td>
</tr>
<tr>
<td>Pea paddocks</td>
<td>4</td>
<td>1.2</td>
</tr>
<tr>
<td>Fire breaks</td>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td>Grasshoppers</td>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td>Spray topping</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>Time of seeding</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>Lupin stubbles</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>Mineral deficiency</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>Cropping</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>Fast tillage speed</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>Growing barley instead of oats</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>Cut worm damage</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>TOTAL</td>
<td>323</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Comments on the prevention of wind erosion resulted in 16 different preventative measures. 75 per cent of the responses were concentrated on four preventative measures, these were; reducing stocking rate (39.4 per cent of responses), avoiding clearing (14.4 per cent of responses), minimum tillage (13.6 per cent of responses) and planting trees (7.6 per cent of responses). The complete list of perceived preventative measures is given in Table 3.

Table 3.2  Number of responses to each perceived method for reducing wind erosion

<table>
<thead>
<tr>
<th>Preventative Measure</th>
<th>No. of responses</th>
<th>percentage of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce stocking rate</td>
<td>52</td>
<td>39.4</td>
</tr>
<tr>
<td>Avoid clearing</td>
<td>19</td>
<td>14.4</td>
</tr>
<tr>
<td>Minimum tillage</td>
<td>18</td>
<td>13.6</td>
</tr>
<tr>
<td>Plant trees</td>
<td>10</td>
<td>7.6</td>
</tr>
<tr>
<td>Burn stubbles</td>
<td>6</td>
<td>4.5</td>
</tr>
<tr>
<td>Plant perennial (Veldt) grass</td>
<td>4</td>
<td>3.0</td>
</tr>
<tr>
<td>Crop/pasture rotations</td>
<td>4</td>
<td>3.0</td>
</tr>
<tr>
<td>Slow tillage speed</td>
<td>4</td>
<td>3.0</td>
</tr>
<tr>
<td>Fence off areas</td>
<td>4</td>
<td>1.5</td>
</tr>
<tr>
<td>Plant crops</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>Repeat crop light country</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>Graze stubbles in summer</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>Stubble mulch</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>Use round bales as wind break</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Reseed stubbles</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Deep plough</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>TOTAL</td>
<td>132</td>
<td>100.0</td>
</tr>
</tbody>
</table>

It is interesting to note that only 1.9 per cent of responses saw lack of shelter as a cause of wind erosion, whilst 22 per cent of responses (14.4 + 7.6) saw avoiding clearing and planting trees as a prevention.

3.2  Case Control Study

A total of 86 interviews were completed, 43 for each of the case and control group. The results of the interviews are discussed in two parts. The first part examines those questions which sought information on the overall environmental and managerial character of the farms. The second part presents those replies which were directed towards the differences in both, the physical properties and management of individual paddocks. Even though the study aimed to identify those factors which were associated with wind erosion, many of the attributes discussed may not necessarily be causal.
3.2.1 The Farms

There was no significant difference between the case and control groups with regards to the district, size of farm, or age, education level and, experience of the farm manager. Nor was there any influence of the farm debt as a percentage of income from those that replied (case 56 per cent, control 67 per cent). The similarity between the two groups for these variables suggests that the selection process eliminated these factors as causal variables, and the study is more likely to identify management and physical factors contributing to wind erosion.

There was however, a number of factors where the differences between the case group and control group were statistically significant:

(a) Environmental and Physical Factors

Farms which experienced wind erosion had a lower mean rainfall (500 mm c.f. 5.7 mm). However, in the period from June 1983 to June 1984, December (60 mm c.f. 83 mm) and January (1.6 mm c.f. 5.7 mm) were the only two months to show a significant difference in rainfall for the case and control farms respectively.

Winds during erosive events came from all points of the compass, but the winds were predominantly from the northwest (65 per cent replies), west (13 per cent) and north (13 per cent) at wind speeds ranging from force four to eight on the Beaufort scale or 20 km hr~ to 74 km hr~. Most farmers (87 per cent) reported winds of force seven and eight (50 km hr 1 to 74 km hr~). Wind erosion tended to occur over a number of hours (45 per cent) but ranged to a number of days (26 per cent) and weeks (29 per cent).

We did not attempt to determine if the control group experienced similar wind conditions. However, it is reasonable to assume that farms in close proximity to each other would have winds of similar magnitude. Therefore, it is likely other factors contributed to wind erosion. Of these, the temporal and spacial distribution of rainfall may be the most significant.

(b) Farm Cropping Practices

While more of the case group grew crops in 1984 than the control group (91 per cent c.f. 62 per cent, P < 0.05), the area they cropped was much less than that of the control group (mean of 315 ha c.f. mean of 547 ha). Similarly, more of the case group cropped barley (79 per cent c.f. 44 per cent) and/or oats (42 per cent c.f. 19 per cent) in 1984.

There were significant differences in the rotation practices for each crop between the case and control groups.

There was a significant (P < 0.05) difference in the crop rotation practice for barley. In the control group 18 per cent used a 1:2 rotation* whilst 45 per cent of the cases used this rotation. Only 10 per cent of the cases used a 1:1 or less rotation compared with 41 per cent of the controls. However both groups had a similar proportion of 1:3 rotations or greater.
There was also a significant ($P < 0.01$) difference in the crop rotation practice for wheat. 77 per cent of the cases used a 1:2 rotation whereas 80 per cent of the controls uses a 1:1 rotation or less. Again similar proportions (8 per cent and 10 per cent) used rotations of 1:4 or greater.

Significantly ($P < 0.05$) more of the case farms seeded either wheat or barley in June or later in 1984.

The evidence suggests that the control group tended to maintain established pastures. This appears to have been achieved by either not cropping at all or, if they cropped, having larger areas and cropping selected paddocks in a 1:1 rotation.

* (A 1:1 rotation means one year in crop and one year out. Likewise 1:2 rotation is a one year in crop and two years out.)

(C) Livestock

Only 39 per cent of both the control and case group had cattle. The numbers with cattle were not enough to draw any conclusions. However, as discussed in the preliminary survey results, the major livestock enterprise in the area is sheep.

The case farms tended to have higher stocking rates and sold more wool, although the average wool cut per head was not significantly different between the two groups.

There was a significantly ($P < 0.01$) higher proportion of farms that were hand feeding in the case group (90 per cent hand feeding) than in the controls (62 per cent hand feeding) in both 1983 and 1984.

A significant ($P < 0.01$) number of farms in the case group (43 per cent) had forced sales of sheep compared with the control group (12 per cent). There were also more forced sales of cattle in the case group than the controls.

The case group were also more likely to have sent sheep away on agistment (31 per cent in 1984, 24 per cent in 1983) than the controls (9 per cent in 1984, 5 per cent in 1983) and this was statistically significant ($P < 0.05$).

Lamb marking percentages for the case group (70 per cent) were significantly lower than for the control group (77 per cent) in 1984, but not in 1983.

An interesting but not readily explainable significant difference ($P < 0.05$) was that case farms were more likely to have Merinos as the dominant breed of sheep.

These results indicate that the case group demand more of their land by carrying more livestock. In order to carry more livestock they have to agist, hand feed more, or are forced to sell their livestock at certain times of the year.
3.2.2 Eroded and Non-eroded Paddocks

To identify factors which were associated with wind erosion, questions were directed towards particular features of a paddock which had eroded, and a comparison was made with a paddock that had not eroded. Only a small number of factors were significantly different between the paddocks; this does not mean other factors did not contribute to wind erosion, but that the questions could not be answered, or the appropriate questions were not asked.

The majority of the eroded paddocks were in pasture, a reflection of the dominance of pasture in the region. As a result there were too few examples to investigate those factors which contribute to wind erosion if a paddock is cropped.

Under pasture, eroded paddocks were more likely (P < 0.05) to have less than 50 per cent plant cover, and a plant height under five centimetres at the time of the erosion event.

There was also a significantly greater chance (P < 0.05) that the eroded paddocks had no shelter, had sheep digging for clover burr, and soils which were deep sands or had a sandy surface.

3.2.3 Comments

The results of the initial questionnaire and interviews suggest that while rainfall distribution is a factor which increases the risk of wind erosion, farmers with a particular management system minimised their risk.

The system which has minimised the wind erosion risk appears to be one which maintains a good plant cover on any areas which are cropped, and a good pasture. This has been achieved by having a very short rotation of 1:1 and less in selected paddocks and having other paddocks remain in pasture, with lower stocking rates.

This system was reflected by the reduced reliance on hand feeding, agistment, and the lower number of forced sales in the control group when compared to the case group.

Since the survey did not attempt to identify cause and effect, the relationship between cropping rotations and wind erosion merits further investigation. Very short rotations, 1:1 or less, appear to be less of a risk as do long rotations of 1:4 or greater.

Judging by the range of replies there appears to be some confusion as to the causes and methods of preventing wind erosion, indicating a strong extension need. Considering the effort put into extending minimum tillage it is surprising that only 13.6 per cent of respondents recognised this as a preventative measure for wind erosion.

On the other hand the importance of plant cover as seen by combining overgrazing, insufficient grass and clover (a total of 26 per cent) rated highly in the causes, and reducing stocking rate the largest single factor in preventative measures (39.4 per cent of responses).
It is interesting to note that 77 per cent of the case group contacted the Western Australian Department of Agriculture an average of four times a year, while only 60 per cent of the controls contacted the Department on an average of 4.7 times a year.
4. References


Appendix I

Preliminary Survey Questionnaire

Covering letter and questionnaire mailed to landholders in 1984
Dear

The problem of wind caused soil erosion has become more obvious in the last few years. As part of the Department of Agriculture research effort your co-operation is sought to complete the accompanying questionnaire. This forms a preliminary survey to establish the extent of the problem along the South Coast of W.A. It is intended that the information derived will lead to an in depth study to establish the factors that lead to soil loss by wind erosion and hence to possible solutions.

The accuracy and value of this questionnaire to the agricultural community is dependent on the number of responses. Therefore your reply is extremely important.

The questionnaire is designed to be completed in only a few minutes and returned in the stamped addressed envelope provided. Answers will be treated with confidence and each questionnaire is identified by a code number so they can be recorded on return. A reminder will be sent at a later date if we have received no reply. A summary of results will be sent to each participating farmer when the results have been analysed.

Thank you in anticipation of your co-operation. Yours sincerely

G.A. Robertson

COMMISSIONER FOR SOIL CONSERVATION
WIND EROSION SURVEY 1984

PLEASE ANSWER ALL QUESTIONS

If you do not own or manage a farm please indicate in the box provided and return the questionnaire.

Don't own or manage a farm

If more than one farm is owned only answer for the farm to which this questionnaire is addressed for all questions.

1. What is the total area of your farm? _______ ha _______ acres

2. What is your average annual rainfall?

THE FOLLOWING QUESTIONS RELATE TO THE PERIOD FROM JANUARY TO JUNE 1984 (i.e. THIS YEAR)

3. What was the cleared area of your farm at June 1984? _______ ha _______ acres

4. What was the total area worked up for cropping to June 30, 1984? _______ ha _______ acres

5. What was the area of your farm STRIPPED BARE BY WIND between January to June 1984?

6. What was the area of your farm that was affected by DUST BLOWING between January to June 1984?

7. What was the total number of cattle on your farm at June 30 1984?

8. What was the total number of sheep on your farm at June 30 1984?

9. What was the total number of other stock species on your farm at June 30 1984? (Please specify)

<table>
<thead>
<tr>
<th>Stock type</th>
<th>Total number</th>
</tr>
</thead>
</table>

15
10. What was the total rainfall on your property (or nearest recording station) from January 1 to June 30 1984? Mm Inches

THE FOLLOWING QUESTIONS RELATE TO THE PERIOD FROM JANUARY TO JUNE 1983 (i.e. THE PREVIOUS YEAR)

11. What was the cleared area of your farm at June 1983?

12. What was the total area sown to crops in 1983?

13. What was the area of your farm STRIPPED BARE BY WIND between January to June 1983?

14. What was the area of your farm affected by DUST BLOWING between January to June 1983?

15. What was the total number of cattle on your farm at June 30 1983?

16. What was the total number of sheep on your farm at June 30 1983?

17. What was the total number of other stock species on your farm at June 30 1983? (Please specify) Stock type Total number

18. What was the total rainfall on your property (or nearest recording station) in 1983? Mm Inches

19. What was the total rainfall on your property (or nearest recording station) in 1982?

What was the total area sown to crops in 1982

Do you have any comments to make on wind erosion?
This completes the questionnaire.

Thank you very much for your co-operation.

Could you please return the questionnaire as soon as possible?

Thankyou.

Thank you very much for your cooperation.
Appendix II

Case/Control Study Questionnaire

Includes:

1. Telephone Introduction used to arrange interview.
2. Introduction to Questionnaire at the interview.
3. Questions 1 to 39 read to both Control and Case.
4. Questions 40 to 96 read to the Control group.
5. Question 40 to 91 read to the Case (eroded) group.
6. List of Options shown and read to subjects.
7. List of Farm Machinery and Methods.
8. List of soil types.
9. List of Fertilisers.
10. Beaufort Scale of Wind Strength.
"This is (your name) from the Department of Agriculture.

I am following up a wind erosion survey, carried out late last year, that you took part in. In that questionnaire, you said you had (some/no) erosion. We are following up by comparing farming practices on farms that had erosion with those that had no erosion, and I would like to be able to interview you sometime in the next (__) weeks.

The interview takes about two hours. If you are willing, what time would be suitable?

* * *

Before I come out, and if available, it would be a great help if you have ready information on:-

1. Rainfall data for each month from June 1983 to June 1984.
5. Agistment dates.
6. Fertiliser usage.
7. Directions.
INTRODUCTION TO SOIL EROSION QUESTIONNAIRE

I would like to thank you for giving up your time to help with this investigation. As you are aware wind erosion causes severe problems throughout this area in some years. The problem of wind erosion is obviously complex. The purpose of this investigation is to try and find relationships between a number of farm practices and wind erosion. We are doing this by comparing farms that reported a problem with wind erosion and other farms where it was not considered a problem.

This survey is part of the National Programme of Soil Conservation Research.

Some of the questions may appear repetitive and I have to read them out to ensure everyone is asked the same question in the same way. The questions relate to the home farm used in last year’s wind erosion survey to which you responded.
QUESTIONS READ TO BOTH CONTROL/CASE GROUPS
EVALUATION OF RISK FACTORS LEADING TO SOIL DE-STABILISATION IN TILE SOUTH COAST AREA OF W.A.

QUESTIONNAIRE 1

CODE NO __________

NAME OF INTERVIEWER ______________________________

PART A (BACKGROUND INFORMATION)

To begin with I would like to ask you some background information about the farm and I would like to point out that all the information you give is confidential.

1. What is the total area of your farm? ____________ ha/acre
2. What is the cleared area? ____________ ha/acre
3. How long have you been involved in the management years of this farm? ____________ years
4. Would you mind telling me your age? ____________ years
5. What level of education have you completed?
   No formal education 1
   Primary only 2
   Secondary (to Year 10) 3
   Agricultural High School 4
   Normal High School (to Year 12) 5
   Trade qualifications (details) 6
   Tertiary education 7
6. How many years of farming experience have you had? ____________ years
7. What is the average annual rainfall of the farm? ____________ mm
8. What was the rainfall for each month from June 1983 to June 1984?

<table>
<thead>
<tr>
<th></th>
<th>Jun 83</th>
<th>Jul 83</th>
<th>Aug 83</th>
<th>Sep 83</th>
<th>Oct 83</th>
<th>Nov 83</th>
<th>Dec 83</th>
<th>Jan 84</th>
<th>Feb 84</th>
<th>Mar 84</th>
<th>Apr 84</th>
<th>May 84</th>
<th>Jun 84</th>
<th>Not Known</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mm</td>
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<td></td>
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</tr>
</tbody>
</table>
PART B (CROPPING)

I would now like to ask you about your cropping enterprises.

9. What was the total area sown to crop in

<table>
<thead>
<tr>
<th>Year</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td></td>
</tr>
</tbody>
</table>

I would like you to look at this card showing commonly used crop establishment methods and machinery used.

10. Using the card which method of crop establishment did you use for the majority of each crop in 1983 and 1984.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Oats</td>
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<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lupins</td>
<td></td>
<td></td>
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<tr>
<td>Other (specify)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

11. If you used conventional working I would like you to estimate the speed of cultivation for each crop. That is hectares per hour and width of machine.

<table>
<thead>
<tr>
<th>Crop</th>
<th>What was the area cultivated per hour</th>
<th>What was the width of the machine (metres)</th>
<th>Unsure/Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lupins</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Other (specify)</td>
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</tbody>
</table>
I would now like you to look at this card which describes soil types.

12. I would like to know what percentage of each crop was planted in each of the soil types? What percentage of [Crop] was planted in [Soil type]

<table>
<thead>
<tr>
<th>Crop</th>
<th>Soil Type 1983</th>
<th>Soil Type 1984</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Barley</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lupins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13. What were the soil moisture conditions at the time of seeding in

<table>
<thead>
<tr>
<th>Condition</th>
<th>1983</th>
<th>1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Drying</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Rained during seeding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Don’t know/Unsure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Variable (more than 2 conditions)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
14. On what dates did seeding start and finish for each crop in 1983 and 1984?

<table>
<thead>
<tr>
<th></th>
<th>First when did seeding</th>
<th>When did seeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lupins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

15. I would like you to look at this card of a list of fertilisers. They are [READ CARD]

<table>
<thead>
<tr>
<th></th>
<th>Which fertiliser did you use in 1983 for:</th>
<th>Again which fertiliser did you use in 1984 for:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lupins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

16. I would like to ask you about your usual crop rotation practice.

Barley
Oats
Wheat
Lupins

Other (specify)
PART C (STOCK ENTERPRISES)

I would now like to ask you some questions about your stock enterprises.

17. What were the numbers of [Stock] at March 31st in [Year]?

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goats</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others (specify)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If no sheep go to Q. 34 [Page __]

18. Regarding the sheep, what numbers of each class of sheep were carried in 1983 and 1984 (at March 31st)?

What numbers of [Class of sheep] were carried in [Year]?

<table>
<thead>
<tr>
<th>Class of Sheep</th>
<th>1983</th>
<th>1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ewes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wethers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lambs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rams</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

19. What is your main breed of sheep? ______

Merino = (1) British Breed (incl. Poll Dorset) = (2)
Cross Bred = (3)

20. Do you breed your own sheep? Yes = (1), No = (2) ___

If no, go to Q. 24 [Page 9] ______

21. In what month is your main lambing? (1 - 12) ______

22. How long after lambing commenced do you usually wean the lambs? ______ weeks
23. What was the lamb marking percentage for 1983? ___ %

1984? ___ %

24. The following are some grazing strategies:

1. Set stocked
2. Rotated every <1 month
3. Rotated every 1—3 months
4. Rotated every >3 months
5. Rotated as necessary

Which of these strategies do you usually use for:

Ewes __
Wethers
Weaners

25. Was any hand feeding of sheep carried out in

1983? Yes (1) or No (2)

1984? Yes (1) or No (2)

[If Yes]


<table>
<thead>
<tr>
<th>Crop</th>
<th>1983 tonnes</th>
<th>1984 tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lupins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
27. For how long was hand feeding carried out in 1984:
   - Ewes __
   - Wethers
   - Weaners

28. Were any fodder crops grown in 1983?
   - Yes = (1), No = (2) ______
   - 1984? Yes = (1), No = (2) ______

29. How many kilograms of wool did you sell in 1983?__
   - 1984? _

30. What was the average wool cut for ewes and wethers in 1983 & 1984?
   - ewes in 1983?
   - ewes in 1984?
   - wethers in 1983?
   - wethers in 1984?

31. How many of the following classes of sheep did you sell up till June 30th each year?

<table>
<thead>
<tr>
<th>How many:</th>
<th>1983</th>
<th>1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ewes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wethers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lambs (prime)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

32. Were any of these sales forced because of seasonal conditions? Yes = (1), No = (2) ______
If so what was the sheep type and numbers:

<table>
<thead>
<tr>
<th>Type</th>
<th>1983 (No)</th>
<th>1984 (No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ewes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weathers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lambs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rams</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

33. Did you purchase any sheep in 1983 or 1984?

<table>
<thead>
<tr>
<th>Year</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If yes how many [Type] in [Year]?

<table>
<thead>
<tr>
<th>Type</th>
<th>1983 (No)</th>
<th>1984 (No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ewes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weathers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lambs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rams</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

34. Were any sheep sent on agistment in 1983 and 1984?

<table>
<thead>
<tr>
<th>Year</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Did you send on agistment [Class of sheep]. What were the numbers, date sent and returned.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ewes</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Wethers</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lambs</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Rams</td>
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<td></td>
</tr>
</tbody>
</table>

35. Do you have any cattle? Yes = (1), No = (2) ______

   If No proceed to Question 39 [on Page 15]

36. What were the numbers of the following classes of cattle carried on March 31?

<table>
<thead>
<tr>
<th>Numbers in 1983</th>
<th>Numbers in 1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females (over 1 y.o.)</td>
<td></td>
</tr>
<tr>
<td>Steers (over 1 y.o.)</td>
<td></td>
</tr>
<tr>
<td>Calves (under 1 y.o.)</td>
<td></td>
</tr>
<tr>
<td>Bulls</td>
<td></td>
</tr>
</tbody>
</table>

37. What was the numbers of [Cattle type] sold to June 30th in:

<table>
<thead>
<tr>
<th>Type</th>
<th>1983 and 1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females (over 1 y.o.)</td>
<td></td>
</tr>
<tr>
<td>Steers (over 1 y.o.)</td>
<td></td>
</tr>
<tr>
<td>Calves (under 1 y.o.)</td>
<td></td>
</tr>
<tr>
<td>Bulls</td>
<td></td>
</tr>
</tbody>
</table>
38. Were any of these sales forced due to seasonal conditions?
   Yes = (1), No = (2) _______

   (If yes) how many [Cattle type] were a forced sale in ______________________

<table>
<thead>
<tr>
<th>Type:</th>
<th>1983</th>
<th>and 1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females (over 1 y.o.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steers (over 1 y.o.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calves (under 1 y.o.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulls</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

39. Did you send any cattle away on agistment in 1983 and 1984?
   Yes = (1), No = (2) _______

   If yes, what (Classes)

<table>
<thead>
<tr>
<th></th>
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</tbody>
</table>
QUESTIONS READ TO CASE
(eroded group)
PART D  THE ERODED AREA

I would now like to ask you some questions about the area you described as stripped bare by wind in 1984. It would help if we confined the questions to the most badly affected paddock.

40. What is the area of the paddock? _______  ha

41. What is the area stripped bare by wind?  ______  ha

42. If you would again look at this card. Which of the soil types best describes the area stripped bare by wind _______

43. When was the paddock cleared? _______     /      /     .

44. Could you estimate the slope of the eroded paddock? _

\(<1\% = (1) \\
1—3\% = (2) \\
3 — 10\% = (3) \\
10 — 30\% = (4) \\
>30\% = (5) \\

A 3\% slope is one where a fall of 3 metres occurs in every 100 metres.

45. Which direction does the slope face? _______

N = (1), NE = (2), E = (3), SE = (4), S = (5), SW = (6),
W = (7), NW = (8)

46. In what part of the paddock did the erosion start?

47. Did the erosion occur over of period of hours/days/weeks? 
   Hours = (1), Days = (2), Weeks = (3)

48. During the erosion event what was the wind direction __
   N = (1), NE = (2), E = (3), SE = (4), S = (5), SW = (6),
   W = (7), NW = (8)

49. Could you estimate the wind velocity during the erosion period from this card. 
   [Use card with the Beaufort scale]
50. Are there any shelter belts or wind breaks for the eroded area?  
Yes = (1), No = (2)  

51. If yes, Where located?  
Which direction is it placed (e.g. N/S)  

52. Was the area pastured (1) or stubble (2)?  
If pastured go to Q.60 [Page 1]  

53. If stubble, was the crop  
Wheat = (1), Barley = (2), Oats = (3), Lupins = (4)  
or others (specify) = (5)  

54. What was the yield of the crop?  
______ tonnes/ha  
______ bags/acre  

55. Was the stubble burnt? Yes = (1), No = (2)  

56. Was the stubble baled? Yes = (1), No = (2), Some baled = (3)  

57. If the paddock was worked prior to the wind erosion occurring, I would like you to look at this card again. Which method of crop establishment did you use? [READ CARD]  
Machinery  
Method  

58. If the paddock was cultivated could you estimate the speed used to cultivate?  
(If not) could you tell me how many ha/hour were cultivated?  
What was the width of the machine used?  
______ (m)  
Not sure  

59. Was the soil moisture at seeding:  
Wet = (1), Moist = (2), Dry = (3), Rained during seeding = (4),  
Drying = (5), Not sure = (6), Variable (more than two conditions) = (7)  

60. What herbicide treatment was used?  
Pre—emergent  
Post—emergent  
None used  
How many cultivations?
61. What was the percentage of weed in the crop at harvest %
   Go to Q. 61

62. In the pasture what was the percentage of grass, clover and weeds?
   Grass % Clover % Weeds %

63. Could you describe the amount of feed immediately prior to the erosion event. Firstly in terms of area covered and secondly height of plant cover including stubble.

   Was there:
   1. 25% cover 2. 25-50% cover 3. 50--75% cover 4. 75-100% cover

   Was the height:
   5. <1 cm height 6. 1—5 cm height 7. 5—10 cm height 8. >10 cm height

64. Had the area been grazed in the 3 months prior to the erosion event? Yes = (1), No = (2)

   (If yes) how many [Stock type]

<table>
<thead>
<tr>
<th>STOCK TYPE</th>
<th>NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHEEP</td>
<td></td>
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<tr>
<td>CATTLE</td>
<td></td>
</tr>
<tr>
<td>OTHER (SPECIFY)</td>
<td></td>
</tr>
</tbody>
</table>

65. How long was the paddock grazed? _______ weeks

   If no sheep go to Q. 68 [Page ]

66. If sheep had been grazing were they digging for burr?
   Yes = (1), No = (2) _______

67. What was the average condition score of the sheep when put into paddock? _______

68. What was the average condition score of the sheep at the time of the wind event?
I would not like to ask you some similar questions about a paddock that did not have wind erosion. Preferably this should be the nearest paddock to the one that blew.

69. What is the area of the paddock? ______ ha

70. If you would again look at this card. Which of the soil types best describes the paddock? ______

71. When was the paddock cleared? / / .

72. What was the slope of the paddock? ______
   <1% = (1)
   1-3% = (2)
   3 -10% = (3)
   A 3% slope is one where a fall of 3 metres occurs every 100 metres.
   10 - 30% = (4)
   >30% = (5)

73. Which direction does the paddock face? ______
   N = (1), NE = (2), E = (3), SE = (4), S = (5), SW = (6),
   W = (7), NW = (8)

74. Are there any shelter belts or wind breaks for the paddock? Yes = (1), No = (2)

75. If yes. Where located? Which direction is it placed (eg N/S) ______

76. Was the area pastured (1) or stubble (2)? ______
   If pastured go to Q.84 [Page ]

77. If stubble, was the crop? ______
   Wheat = (1), Barley = (2), Oats = (3), Lupins = (4)
   Other (specify) = (5)

78. What was the yield of the crop? ______ tonnes/ha
   ______ bags/acre

79. Was the stubble burnt? Yes = (1), No = (2) ______

80. Was the stubble baled? Yes = (1), No = (2), Some baled = (3)

81. I would like you to look at this card again. Which method of crop establishment did you use?
82. If the paddock was cultivated could you estimate the speed used to cultivate? _______ km/hr
(If not) or could you tell me how many ha/hour were cultivated? ___

What was the width of machined used? _______ (m)
Not sure _______

83. Was the soil moisture at seeding: _______
Wet = (1), Moist = (2), Dry (3), Rained during seeding = (4), Drying = (5), Not sure (6) Variable (more than 2 conditions) = (7)

84. What herbicide treatment was used?
Pre—emergent
Post—emergent
None used
How many cultivations?

85. What was the percentage of weed in the crop at harvest %

86. In the pasture what was the percentage of grass, clover and weeds?
Grass % _______ Clover % _______ Weeds % _______

87. Could you estimate the amount of dry feed immediately prior to the erosion event? Firstly in terms of area covered and secondly height of plant cover.

Was there:
1. 25% cover  2. 25-50% cover  3. 50--75% cover  4. 75-100% cover

Was the height:
5. <1 cm height  6. 1—5 cm height  7. 5—10 cm height  8. >10 cm height

88. Had the area been grazed in the 3 months prior to the _ erosion event?Yes = (1), No = (2)
89. (If yes) how many [Stock type]

<table>
<thead>
<tr>
<th>STOCK TYPE</th>
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<tbody>
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<td></td>
</tr>
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<td>OTHER (SPECIFY)</td>
<td></td>
</tr>
</tbody>
</table>

90. For how long was the paddock grazed? _____ weeks

If no sheep go to Q. 92 [Page ]

91. If sheep had been grazing were they digging for burr?
   Yes = (1), No = (2) _____ _____

92. What was the average condition score of the sheep when put into paddock? _____

93. What was the average condition score were the sheep at the time of the wind event? _____

I would like to ask you some questions about the debt status of the farm. You are not obliged to answer these questions if you do not wish. I would remind you of the confidentiality of the information.

94. What was your gross debt at June 30th 1984?

95. What was the gross income (all sources, on and off farm) for 1984?

96. During 1984 how often did you receive advice from:

<table>
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<tr>
<td>W.A. Dept. of Agriculture</td>
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</tr>
<tr>
<td>Other agricultural consultants (specify)</td>
</tr>
<tr>
<td>Nil professional advice</td>
</tr>
</tbody>
</table>

That concludes the questionnaire. Thankyou very much for your co-operation and help. I would like to restate that all the information is confidential.
QUESTIONS READ TO CONTROL GROUP
(non-eroded)
PART D - THE NON-ERODED AREA MOST LIKELY TO SUFFER WIND EROSION

I would not like to ask you some similar questions about a paddock that you consider to be the most likely to suffer from wind erosion. The questions refer to the paddock history up to June 30 1984.

40. What is the area of the paddock? ha

41. If you would again look at this card. Which of the soil types best describes the paddock?

42. When was the paddock cleared? / / .

43. What was the slope of the paddock?
   <1% = (1)
   1-3% = (2)
   3-10% = (3)
   10-30% = (4)
   >30% = (5)

   A 3% slope is one where a fall of 3 metres occurs every 100 metres.

44. Which direction does the paddock face?
   N = (1), NE = (2), E = (3), SE = (4), S = (5), SW = (6), W = (7), NW = (8)

45. Are there any shelter belts or wind breaks for the paddock?
   Yes = (1), No = (2)

46. If yes. Where located? ________________________________

   Which direction is it placed (eg N/S)

47. Was the area pastured (1) or stubble (2)?

   If pastured go to Q.84 [Page ]

48. If stubble, was the crop
   Wheat = (1), Barley = (2), Oats = (3), Lupins = (4) or others (specify) = (5)

49. What was the yield of the crop? tonnes/ha
   bags/acre

50. Was the stubble burnt? Yes = (1), No = (2)

51. Was the stubble baled? Yes = (1), No = (2) Some baled = (3)
52. I would like you to look at this card again. Which method of crop establishment did you use in 1984?

Machinery __________ Method __________

53. If the paddock was cultivated could you estimate the speed used to cultivate?

(If not) could you tell me how many ha/hour were cultivated? ______

What was the width of the machine used? (m)

Not sure

54. Was the soil moisture at seeding:

Wet = (1), Moist = (2), Dry = (3), Rain during seeding = (4), Drying = (5), Not sure = (6), Variable (more than two conditions) = (7)

55. What herbicide treatment was used?

Pre—emergent

Post—emergent

None used

How many cultivations?

56. What was the percentage of weed in the crop at harvest in 1983?

Go to Q. 61

57. In the pasture what was the percentage of grass, clover and weeds?

Grass % ______ Clover % ______ Weeds % ______

58. Could you describe the amount of feed at about the end of June 1984. Firstly in terms of area covered and secondly height of plant cover.

Was there:

1. 25% cover 2. 25-50% cover 3. 50--75% cover 4. 75-100% cover

Was the height:

5. <1 cm height 6. 1—5 cm height 7. 5—10 cm height 8. >10 cm height

59. Had the area been grazed in the 3 months prior to ___ June 30th 1984? Yes = (1), No = (2)

(If yes) how many [Stock type]
I would now like to ask you some questions about a paddock that you consider to be the least likely to suffer from wind erosion. The questions refer to the paddock history up to June 30th 1984.

60. How long was the paddock grazed? weeks

   If no sheep go to Q. 68 (Page ]

61. If sheep had been grazing were they digging for burr?
   Yes = (1), No = (2)

62. What was the average condition score of the sheep when put into paddock?

63. What was the average condition score of the sheep at June 30th 1984?

64. What is the area of the paddock? ha

65. If you would again look at this card. Which of the soil types best describes the paddock?

66. When was the paddock cleared? / / .

67. What was the slope of the paddock?
   <1% = (1)
   1 - 3% = (2)
   3 - 10% = (3)
   10 — 30% = (4)
   >30% = (5)
   A 3% slope is one where a fall of 3 metres occurs every 100 metres.

68. Which direction does the paddock face?
   N = (1), NE = (2), E = (3), SE = (4), S = (5), Sw = (6),
   W = (7), NW = (8)

69. Are there any shelter belts or wind breaks for the paddock?
   Yes = (1), No = (2)
70. If yes. Where located? ____________________________________________

    Which direction is is placed (eg N/S)

71. Was the area pastured (1) or stubble (2)?

    If pastured go to Q.84 [Page ]

72. If stubble, was the crop?
    Wheat = (1), Barley = (2), Oats = (3), Lupins = (4)
    Other (specify) = (5)

73. What was the yield of the crop?  tonnes/ha

    bags/acre

74. Was the stubble burnt? Yes = (1), No = (2)

75. Was the stubble baled? Yes = (1), No = (2) Some baled = (3)

76. I would like you to look at this card again. Which method of crop
    establishment did you use in 1984?  

    Machinery  ___________ Method  ___________

77. If the paddock was cultivated before June 30th 1984 could you
    estimate the speed used to cultivate?

    (If not) or could you tell me how may ha/hour were cultivated? ___

    What was the width of machined used?  (m)

    Not sure

78. Was the soil moisture at seeding:
    Wet = (1), Moist = (2), Dry = (3), Rained during seeding = (4),
    Drying = (5), Not sure = (6) Variable (more than 2 conditions) = (7)

79. What herbicide treatment was used?

    Pre—emergent

    Post—emergent

    None used  How many cultivations?

80. What was the percentage of weed in the crop at harvest in 1983?  %

81. In the pasture what was the percentage of grass, clover and weeds?
Could you estimate the amount of dry feed at about the end of June 1984? Firstly in terms of area covered and secondly height of plant cover.

Was there:

1. 25% cover  
2. 25-50% cover  
3. 50-75% cover  
4. 75-100% cover

Was the height:

5. <1 cm height  
6. 1—5 cm height  
7. 5—10 cm height  
8. >10 cm height

Had the area been grazed in the 3 months prior to June 30th 1984? Yes = (1), No = (2)

(If yes) how many [Stock type]

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For how long was the paddock grazed?  weeks

If no sheep go to Q. 92 [Page ]

If sheep had been grazing were they digging for burr?  
Yes = (1). No = (2)

What was the average condition score of the sheep when put into paddock?

What was the average condition score were the sheep at June 30th 1984?

I would like to ask you some questions about the debt status of the farm. You are not obliged to answer these questions if you do not wish. I would remind you of the confidentiality of the information.

What was your gross debt at June 30th 1984? ______

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During 1984 how often did you receive advice from:

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<td>(specify) -</td>
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</tbody>
</table>

That concludes the questionnaire. Thankyou very much for your co-operation and help. I would like to restate that all the information is confidential.
List of Machinery and Methods

**MACHINERY**

1. DISC PLOUGH
2. BLADE PLOUGH
3. ROD WEEDER
4. CHISEL PLOUGH
5. SCARIFIER
6. WIDELINE CULTIVATOR OR CULTIVATOR BAR
7. HEAVY HARROWS
8. LIGHT COVERING HARROWS
9. TYNED COMBINE
10. **CONVENTIONAL DISC DRILL**
11. **AIR SEEDER**
12. **CULTITRASH OR SIMILAR**
13. **TRIPLE DISC DRILL (E.G. BETTINSON OR DUNCAN)**

**METHOD**

1. SPRAY SEED I.C.I. SPRAY SEED
2. SPRAY SEED ROUNDUP
3. DIRECT DRILL NO HERBICIDE
4. CONVENTIONAL WORKING
List of Soil Type

1. DEEP SAND > 50 CM
2. SAND OVER GRAVEL
3. SAND OVER CLAY
4. SANDY/GRAVEL
5. CLAY
6. OTHER (SPECIFY)

List of Fertilisers

1. SUPERPHOSPHATE
2. SUPER & COPPER
3. SUPER, COPPER & ZINC A
4. SUPER, COPPER & ZINC B
5. SUPER, COPPER & MOLYBDENUM NO. 1
6. SUPER, COPPER, ZINC & MOLYBDENUM NO. 2
7. SUPER & MOLYBDENUM
8. SUPER & COBALT
9. SUPER & MANGANESE
10. 5-1 SUPER & POTASH
11. 3-2 SUPER & POTASH
12. AGRAS NO. 1
13. AGRAS NO. 2
14. AGRAN 34—0
15. UREA
16. DOUBLE SUPERPHOSPHATE
17. OTHER - SPECIFY
### Beaufort Scale of Wind Strength

<table>
<thead>
<tr>
<th>FORCE</th>
<th>DESCRIPTION</th>
<th>SPECIFICATIONS FOR ON LAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Light breeze</td>
<td>Wind felt on face; leaves rustle; ordinary vane moved by wind.</td>
</tr>
<tr>
<td>3.</td>
<td>Gentle breeze</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
</tr>
<tr>
<td>4.</td>
<td>Moderate breeze</td>
<td>Raises dust and loose paper; small branches are moved.</td>
</tr>
<tr>
<td>5.</td>
<td>Fresh breeze</td>
<td>Small trees in leaf begin to sway; crested wavelets form on inland water.</td>
</tr>
<tr>
<td>6.</td>
<td>Strong breeze</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
</tr>
<tr>
<td>7.</td>
<td>Near gale</td>
<td>Whole trees in motion; inconvenience felt when walking against wind.</td>
</tr>
<tr>
<td>8.</td>
<td>Gale</td>
<td>Breaks twigs off trees; generally impedes progress.</td>
</tr>
<tr>
<td>9.</td>
<td>Strong gale</td>
<td>Slight structural damage occurs (chimney pots and slates removed).</td>
</tr>
</tbody>
</table>