
PSYCHOMETRIC TESTING FOR ASSESSING FARMER'S MANAGERIAL ABILITY

(AND MODELLING THE ORIGINS OF ABILITY)

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SUMMARY

The key resource in efficient production is the management input used to coordinate the land, labour and capital. Yet, our understanding of this resource is still somewhat limited, especially the factors involved in improving the managerial ability of farmers. This paper summarises three tests developed to help assess managers, and uses the data collected through random surveys of all types of farmers to explain the origins of managerial ability. Survey data on the competencies farmers' believe are important in successful management is reviewed, and finally a computer based teaching package to develop the important competencies is outlined. The tests developed cover managerial style, the locus of control, and aptitude.

Key words... managerial ability, psychometric tests, improving ability.

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1. INTRODUCTION

Being able to measure farmers' managerial ability through simple written tests would enable useful predictions. Equally as important, understanding the factors that give rise to good managerial ability would enable designing training programmes to improve farmers' inherent skill. It is very likely that the characteristics that the tests measure would be the precursors of good ability.

This paper reports on the development of three tests that may prove to be useful. It also reports on an attempt to model managerial ability using a structural equation approach. One of the tests features in this model.

The first test was designed to classify farmers into 'managerial style' groups. These largely relate to individual personalities. Some farmers, for example, tend to be anxious and risk averse due in part to their genetic makeup, and also their experiences. It is thought (Matthews and Deary, 1998) personality is approximately 35% genetic.

The second test, the 'locus of control', is designed to measure a farmers' belief in how much control they have over farming outcomes. Clearly farmers who tend to believe outcomes are largely determined by outside influence, including the weather, may well benefit from demonstrations and discussions leading to a greater belief in their personal control of outcomes.

A 'managerial aptitude' test was the third question set developed. It was designed to predict managerial ability, though it does appear that more basic information readily available (e.g. formal education level) is just as good, though neither is particularly successful.

The structural equation model involves elements that are likely to be the precursors of good management. Logically, you would expect a farmer's intelligence, personality, objectives, and education to all be originators of ability. Similarly useful experience. The data from a nation wide postal survey was used to test the model. Similarly it was used to quantify the tests.

The discussion proceeds with sections describing and analysing each of the tests. It then contains a section on developing the model of ability and the results of applying the data to the model. Finally, the results of a survey to assess what farmers' think are the important competencies within farm management are presented together with a description of a farmer orientated computer package designed to improve their managerial skills.

2. MANAGERIAL STYLE (PERSONALITY)

A set of 25 questions were designed to explore a farmers' managerial style. It was considered, for example, that some farmers are very conscientious over decisions and their implementation, others more relaxed and intuitive in their

approach. Another example is that some farmers tend to consult others a lot in contrast to relying totally on their own judgements. The question set (see Appendix A) was constructed from the five factor personality theory (Matthews and Deary, 1998) which is generally accepted by psychologists following extensive research. This contends that personality consists of the traits openness, conscientiousness, extroversion, agreeableness and anxiousness. Consequently five questions were created to explore the degree of each trait, giving a total of 25 questions. As it turned out, farmers exhibited six management styles.

The question set consists of statements like ‘when the pressure is on you sometimes become cross and short with others’, and, ‘for most things you seek the views of many people before making changes to your operation’. The farmer is asked to score each statement on a 1 (true) to 5 (not true) scale.

The answers from the 700 or so randomly selected farmers across all regions and farm types who responded to a mail survey have provided benchmarks for future comparisons. Clearly there are no right or wrong answers, rather each answer set provides a unique profile of a farmers’ style which can be used in understanding a farmers’ approach. Of course, it might be found that certain styles tend to correlate with high ability.

The pooled data was used in a factor analysis. The results indicated style was made up of six factors. These were called:

- 1) concern for correctness
- 2) conscientious planning
- 3) thoughtful creativity
- 4) community spirit
- 5) consultative logician
- 6) benign management

Each farmer has a particular level of each factor in his or her management approach which together makes the whole. The importance (factor loadings on a 0 to 1 scale) of each question from the total set making up each factor is also listed in Appendix A beside each question. Some questions do not relate at all to a factor in which case the ‘importance factor’ (loading) is left blank.

Factor one involves anxiety over getting decisions right and jobs performed satisfactorily. Factor two expresses the range of conscientiousness that people exhibit – this is not to be confused with factor one as someone can be conscientious without worrying about outcomes. Factor three measures a persons’ creativeness, and excitement at new ideas and the acceptance of change. Factor four relates to a managers’ desire to interact with others, whereas factor five expresses a farmers’ use of family and friends in testing his or her logic. Factor six relates more to accepting outcomes without rancour or concern.

While everyone will have their idea on what is an ideal mix of the factors for successful management, in the end consultants must work with individual personalities to assist and support them in achieving their goals no matter what the style they exhibit. However, it is interesting to note the relationships between managerial style and farmers’ objectives. In the mail survey the respondents were

asked to score a range of possible objectives. This data was summarized using correlation analysis to conclude on the five core objectives (objective orientation). These core objectives were then correlated with the six core managerial style factors. Table 1 contains the results. Under ‘objective orientation’ are listed the five core objectives.

Table 1: correlations between managerial style factors and objectives

Objective orientation	Style Factors					
	Correctness	Conscientiousness	Creative	Community	Consultative	Benign
Profit	0.096**	0.313**	0.23**	0.134**	0.157**	0.023
Quality	-0.002	0.289**	0.2**	0.12**	0.88*	0.001
Family–Community	0.120**	0.273**	0.075**	0.207**	0.126**	0.002
Balanced	0.001	0.191**	0.455**	0.427*	0.166**	-0.012
Risk aversion	0.121**	0.209**	-	-0.043	0.088*	-
			0.106**			0.083*

Note - ** means ‘highly significant’ and * ‘significant’, lack of any stars indicates the value is not statistically different from zero

As with the management style, any one farmer will have a portion of each objective, but the weighting on each will vary with individuals. Some, for example, will be more profit orientated, and less, for example, quality of life orientated, and vice versa.

The strongest correlations are between the creative and community styles with a ‘balanced’ objective. On the other hand, the correctness component of style is virtually unrelated to the ‘balanced’ objective.

Also of importance is the relationship between managerial style and managerial success. To explore this all the farmers were grouped into one of ten style categories using cluster analysis. The clusters, together with each farmer’s gender, age (years) and education level, was used to predict each farmers’ self rated managerial ability (on a 1 to 10 scale). The equation was:

$$\text{Ability} = 3.54 + 0.16 S + 0.47 A(\text{ge}) + 0.19 E(\text{ducation}) + 0.05 M$$

where:

S = 1 for male and 2 for female,

A = age group with 1<25 yrs....6>65 yrs,

E = 1 for primary school....5 for 2 or more years tertiary,

M = the style cluster membership

The R value was 0.33, so there are certainly many other factors in explaining self rated ability – Furthermore, management style contributes only a small part of managerial ability. This assumes farmers do have a reasonable idea of their ability, and reported this correctly. Generally, research has shown people tend to over inflate

such scores, but what is more important is the accuracy in reflecting the relative ability to others (see, for example, Fitzgerald et al 2003, Gramzow et al, 2003, and Das et al, 1998).

Overall, however, age and education are better predictors than 'style', but this idea is explored more fully in the next section. Despite this, it is likely an understanding of a farmers' style gives guidance on how best to interact with them. An astute consultant probably quickly assesses style through careful observation. Use of the test can speed up this process and forms a basis for discussion with the farmer.

3. LOCUS OF CONTROL

The concept of a persons' belief in how much of the environment within which he or she works is controllable has been recognized for some time. (see for example, Miller et al, 1982; Millet, 2005). However, most of the work in this area has been non-agricultural so it was necessary to create a set of questions suitable for farmers that reflect their control attitude. Appendix B list the questions used.

The respondents were asked to score the questions on a 1-5 truth scale. Depending on the question, each was then scored a 5 if the answer reflected a strong control belief, and vice versa. Each individuals control score was then obtained by adding up their total score and adjusting it to reflect a percentage grade with 100% representing a total control belief.

The average score turned out to be 71% with the following distribution:

<50%	0.3%
50-60%	9.6%
61-70%	37.2%
71-80%	41.3%
81-90%	10.6%
>90%	0.6%

It is interesting to note some 10% believe their control is not great and similarly only 11% believe they have a very high level of control.

To understand the underlying factors in the farmers' beliefs a factor analysis was carried out on the questions. This indicated seven underlying factors appeared to explain the farmers' belief. These factors were labelled (based on the questions in the set they relate to):-

1. Beyond control.
2. Experienced traditionalist.
3. People managers.
4. Introspective acceptor.
5. Determined planner.
6. Successful acceptor.
7. Extrovertic planner.

Each farmer has a portion of each factor in their inherent attitude, with the balance reflecting their overall control belief. For example, farmers with a high proportion of factor one have little control belief and accept outcomes are largely luck, whereas farmers with a high proportion of factor two believe you make your own luck through using tried and tested systems.

The subsequent factors in the list reflect aspects that people can be successfully managed, good managers are born not made, determined planning helps control, training does improve a person's birthright, and finally, factor seven reflects the importance of including others' wants in the plans and, consequently, having control over the system.

Of course, what is important is the relationship between the locus of control test score and desired outcomes. Thus the farmers were asked to give their average annual change in cash profit over the last five years (as a percentage), and similarly for their total asset value.

Using regression analysis, it was found that:

$$\% \text{ Profit change} = 1.515 \text{ Age} + 2.713 \text{ Intelligence} + 0.128 \text{ Locus test score}$$

$$\% \text{ Asset change} = 14.045 \text{ Intelligence} - 8.566 \text{ Age} + 2.538 \text{ Locus test score}$$

where 'age' was a score of 1 < 25 years...6 > 65 years and 'intelligence' was a self rated score of 5 = highly intelligent.... 1 = other.

The first equation had an R value of 0.519, the second 0.687. Both equations were highly significant, but the variables ranged in significance from highly significant to a 16% chance of being no different from zero.

The equations would suggest age and intelligence are important in the outcomes (as you would expect), but also the farmers control belief is a significant factor. Both equations go through the origin and the R value indicates other factors must also be important (for example, farm location and type would impinge on the total asset value change).

As with the style test, it would be useful to be able to predict a farmers' control belief from more basic, readily available data. To test this possibility various equations were tried with the following proving to be the best.

$$\text{Control \%} = 58.65 + 1.51 \text{ Education} - 2.59 \text{ Sex} + 0.52 \text{ Ability} + 0.06 \text{ Aptitude}$$

Where Sex was 1 for male, 2 for female; Ability was a self rated score of managerial ability (1 to 10) and Aptitude a score equivalent to intelligence (see the next section).

The variables and the equation were all at least significant at the 8% level, but the R value was 0.38 indicating other non-measured factors are probably also important. Given the R value it must be concluded it is probably better to use the Locus of Control test than this predictor equation. Nevertheless, it is clear education and gender are important in determining a farmer's control belief. It is not clear from the

research whether the control belief is a manifestation of personality, or whether the measure is an independent characteristic of humans that is only marginally explained by the variables listed above.

4. APTITUDE QUOTIENT

The ultimate test would be one predicting a farmer's overall managerial ability. The equivalent in the general world is the intelligence test. It could well be that standard intelligence tests do correlate with managerial ability. But, most farmers would not willingly take such tests. Consequently a set of questions related to primary production were constructed and pre-tested on a group of farmers. The final set was then administered to a sample through a postal survey.

The question set was divided into sections, each being designed to test a component of intelligence as set out by Sternberg (1988) whose theories on intelligence are now widely accepted. The question sets covered memory (11 questions), experience (5), creativity (3), general (13), shapes (3) and calculations (4). Due to their length the questions are not listed here. As it turned out the correlations between the test scores and the measures of managerial ability were not as good as might be expected. This is why the full set is not provided.

The correctness of the answers varied quite markedly from 87% to 9%. The questions that were too easy or too difficult were dropped. The answers from the remaining set were scored depending on their level of correctness and then adjusted so the average score was set to 100% (in the same way as an intelligence test). This score was called a managerial 'aptitude quotient', or AQ for short. The distribution was as follows:

Aptitude Range	Quotient	Percentage of Sample in each range
0-20		2.4
21-40		7.0
41-60		3.8
61-80		11.0
81-100		16.5
101-120		28.0
121-140		19.6
141-160		8.8
>160		1.6

While the distribution has quite an extensive tail on either side, the majority of respondents fell in the 61-140% range. Some of the respondents were agricultural students so it was interesting to divide out each group to discover the farmers had an average AQ of 106.7% and the students 78.7% - a somewhat telling figure, though when the degree students were separated from the diploma students their average AQ was 100.2%.

Of more importance with respect to the farmers however, was the relationship between the AQ and measures of managerial ability. The respondents gave their self rated 1 to 10 score on overall ability as well as the percentage change in cash profit over the last five years (per year average). They also provided their percentage change in total asset value over the five years. As each of these measures is likely to relate to real ability, the correlations were calculated and combined to form an 'outcome' variable encompassing each components' factor importance. This was then regressed against the various variables. The correlation between 'outcome' and the AQ was 0.187 (highly significant) indicating 'outcome' has a 19% correlation with the test AQ%. While this does help in predicting ability, there are clearly many other factors involved. Consequently various equations were tested with the best being:

$$\text{Outcome} = -0.118 + 0.89 \text{ Age} - 0.013 \text{ Education} + 0.13 \text{ Intelligence} + 0.003 \text{ Locus of control} - 0.001 \text{ AQ}.$$

The R value was 0.38 again indicating many other factors are involved, and some of the variables were not significant (the constant (-0.118), and education), and the locus of control and AQ were only partially significant. On the other hand, when the components of 'outcome' were separated out the equations improve. These are:

$$\text{Self rated managerial ability} = 9.012 - 0.2 \text{ Education} + 0.881 \text{ Intelligence} + 0.016 \text{ Locus of control} - 0.003 \text{ AQ}.$$

with an R value of 0.44.

$$\text{Average profit \% change} = 3.56 + 1.79 \text{ Age} - 0.22 \text{ Education} + 0.43 \text{ Final \% grade} - 3.24 \text{ Intelligence} + 0.031 \text{ AQ}$$

R = 0.219

$$\text{Total Asset \% change} = 66.96 - 12.05 \text{ Intelligence} - 8.9 \text{ Ability change} + 0.85 \text{ AQ}$$

R = 0.26

Overall, however, the aptitude quotient is not particularly important in explaining self rated ability, nor the profit and asset value changes. These measures of success, it should be noted, are totally dependent on the farmers correctly reporting the true situation. Inaccuracies will be one reason why the relationships were not good predictors, but despite this it must be questioned whether a paper test can reflect such a practical occupation as primary production. Alternatively, the question set needs major changes to better reflect success in managing primary resources.

5. A MODEL OF MANAGERIAL ABILITY

It is hypothesized that ability is dependent on a person's genetic makeup (intelligence, personality, and possibly objectives), education and training, as well as experience. The latter may well modify personality and the objectives. That is, a person is dependent on their genetic makeup together with the environment they have experienced from an early age. This is expressed in Figure 1.

Using the survey data an attempt was made at quantifying this model using the structural equation package AMOS (1999). Not all the data necessary was available so various assumptions were required.

To summarise the farmers' objectives into a single variable, each factor was weighted using subjectively assessed weights. The *profiteer* factor was weighted by 2 under the assumption that a farmer strongly in favour of this facet is more likely to be concerned with good management, similarly for the *quality* seeking facet. In contrast the *family-community* facet was negatively weighted by 0.5 assuming that farmers strongly supportive of family and community were less likely to give priority to quality management. Similarly for farmers minimising *risk* as an objective – thus this facet was weighted -1.0. Finally, farmers interested in a '*balanced* existence' were regarded as being neutral with respect to their concern for quality management. While alternative weightings could provide improved explanations, the sensitivity of the results to variations in the weights, as discussed below, suggest otherwise.

Similarly, to summarise the farmers' management style, the management style factors were weighted using 2 for '*conscientiousness*', 2 for '*innovator*', 1 for '*community*', but -1 for each of '*benign*', '*anxiety*' and '*support*' on the grounds that conscientiousness and innovation are likely to enhance a desire for good management, community spirit somewhat neutral, whereas the other factors are likely to be negative influences. An alternative approach to using these weightings would have been to factorise the factors down to a single variable. This approach, however, fails to recognise the likely logical importance of each factor to efficiency. Furthermore, it did not produce significantly different results.

Finally, as observations on the farmers' 'background' were not available, this variable was divided into two with the first being treated as unknown, and the other, as it gives rise to some of the observed variables, being constructed from percentages of these known variables. This approach gives multicollinearity, but this would be expected. The two important components of 'background' stem from the farmers original family environment, and the environment that is external to the family – 'external environment' (e.g. the school environment, community environment...). The family environment ('family origins') provides the farmer's genetic makeup, as well as many developmental influences. Given the comments reported earlier about the influence of genotype, it was assumed the 'family influence' variable was made up of 0.5 of the personality factor, 0.7 of the intelligence score, 0.5 of the objective factor and 0.7 of the education score. This assumes intelligence is more genetically based than personality, and that the degree of education is quite heavily family determined.

Using age as a proxy for experience (clearly this is not ideal so further research is required on this aspect), the data was used to determine the following structural equation (Figure 2) model of ability.

The coefficients on each box give the proportion explained (have a preceding zero), and the figures on the arrowed lines give the influence of the factor (standardized estimates). The rectangles are the observed variables, the circles unobserved (er1 refers to the error variable for management style, and similarly for the other variables).

Figure 1 A structural model of managerial ability

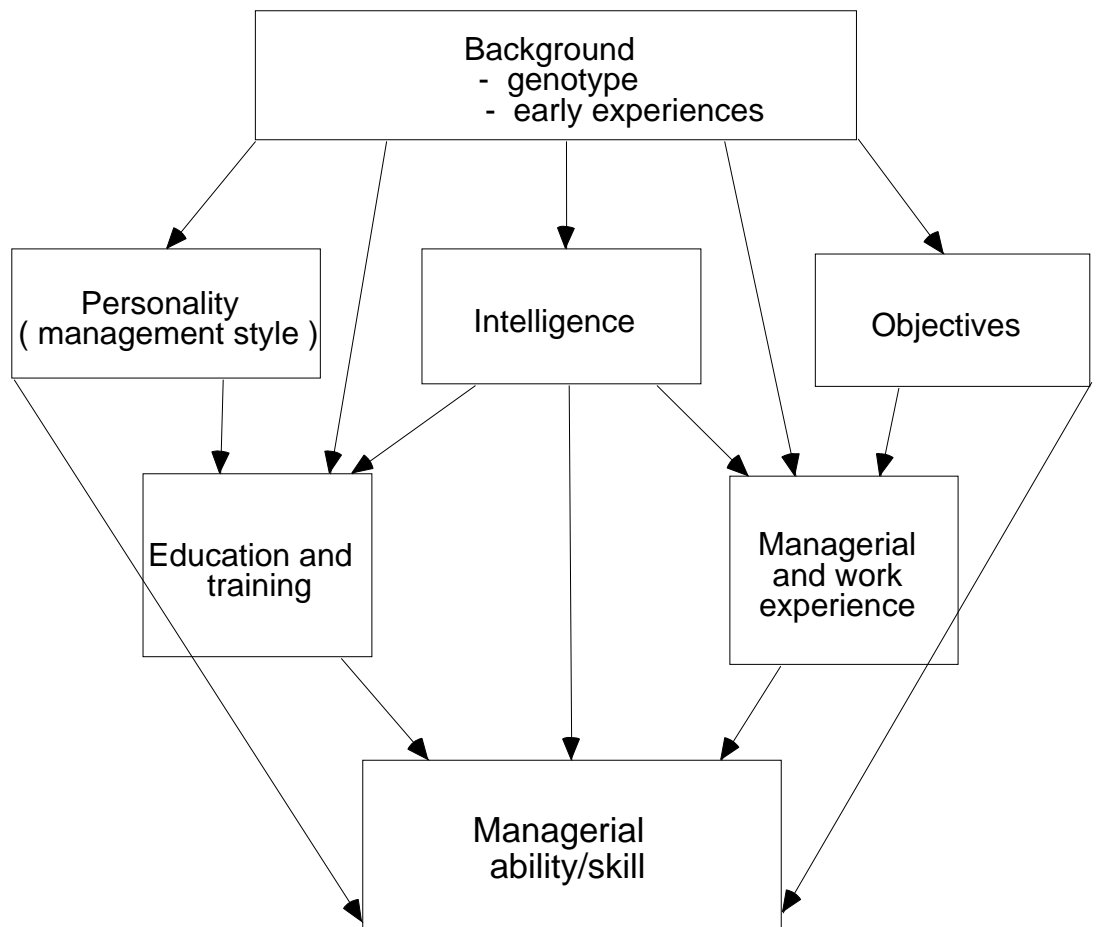
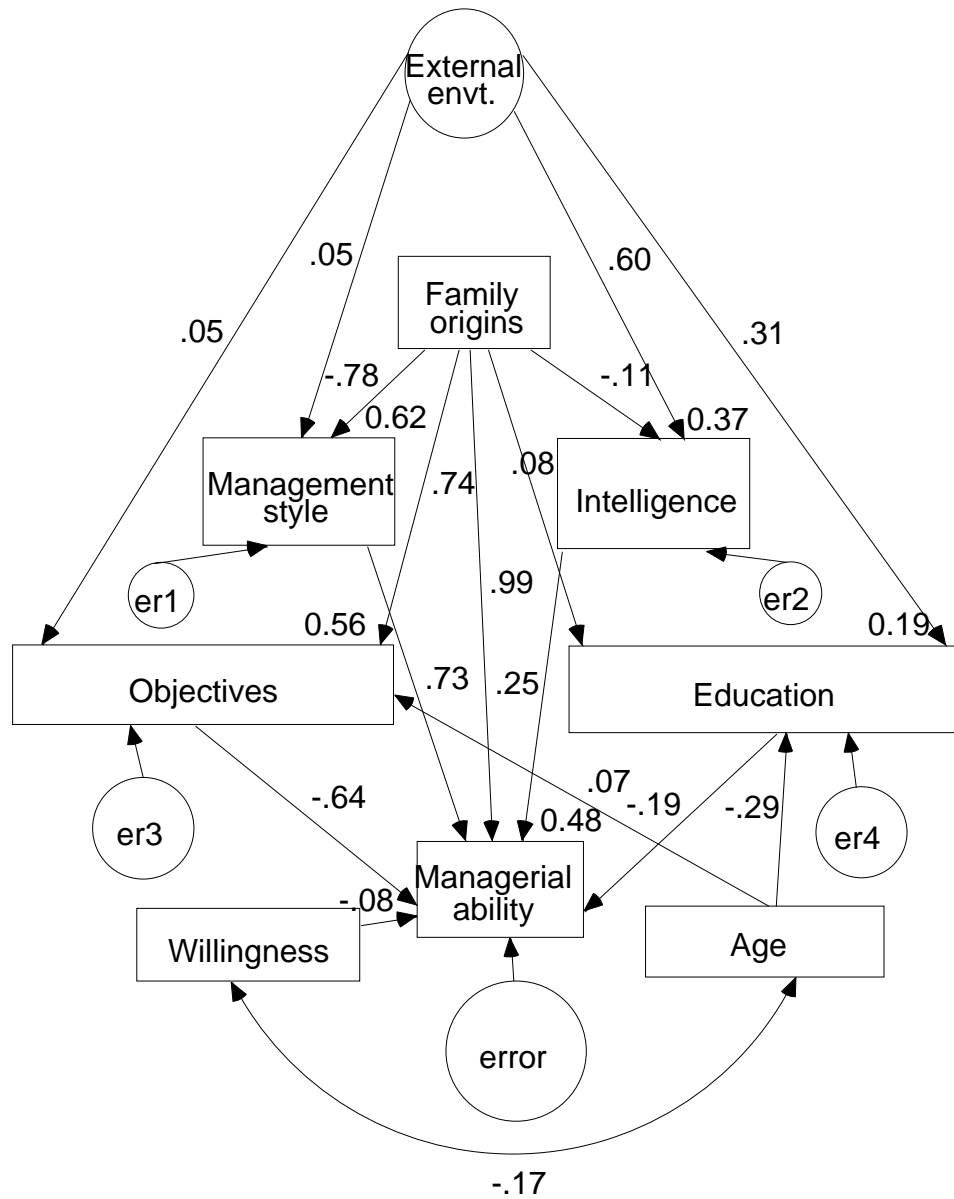


Figure 2 Structural equation of managerial ability.



Where the regression weight on the direct link between ‘family origins’ and ability is set at 0.3 to provide identification (based on the likely genetic influence), the model explains 48% of the variance in managerial ability, and has a Chi-square of 557, a CMIN/DF of 37.2, CFI of 0.97, RMSEA of 0.21, a MECVI of 0.75, and a HOELTER of 46 (see Amos, 1999) and as such must be regarded as only partially successful (desirable values are CMIN/DF 2 or less, CFI > 0.9, RMSEA < 0.1, MECVI close to 0.9, and HOELTER > 200). Note that the negative signs on the variables is due to the scoring direction. For example, statements on the objective were scored 1 for true, 5 for untrue.

The direct impact of 'family origins' on ability appears to be important as does its influence on managerial style (personality) and objectives. This is to be expected as the nurturing family is important in defining a person, as well, it seems, their managerial ability, perhaps through being exposed to decision making from an early age. Consequently, it would be interesting to explore parent-offspring ability correlations at a future date. Of course, given the construction of the 'family origins' variable, these relationships are to be expected. Nevertheless, they are logical.

Age, which is used as an experience proxy, is related to education, willingness to attend training courses and, marginally, to objectives. These relationships probably reflect that older farmers had less educational opportunities and a lower desire for training simply due to their age. Clearly more work in measuring relevant experience is desirable. The model suggests that both the management style and objectives are important determinants of ability, but education, and intelligence per se are somewhat less important.

The external environment impacts, which were determined by implication, are factors in determining intelligence and education, both variables probably relying on schooling as an external entity. The 0.6 value on the impact of the external environment on intelligence was not expected. Either schooling and culture is more important than generally expected, or the self assessment of intelligence needs to be questioned. However, it is interesting to note that education and intelligence were significantly correlated at 0.222 (@ 1% level), and similarly managerial ability and intelligence at 0.297 (@ 1% level). Furthermore, while there has been no research of the accuracy of self assessment by farm managers, work in other areas tends to suggest self assessments are sometimes inaccurate for a variety of reasons (e.g. self enhancement, lack of experience.....), but they do provide relatively accurate rankings (for example, see Fitzgerald et al, 2003; Gramzow et al, 2003; Das et al, 1998). Of course, the ability to self assess is critical in learning from experience.

Overall, this set of data suggests the family origins are particularly important determinants of managerial ability both in a direct sense, and through their influence on managerial style and objectives. However, intelligence is also an important factor in ability. In addition, the original model was re-specified with the 'family origins' variable set as 'unobserved' and without the direct link between the external environment and intelligence. This model explained 42% of the variance and had slightly better goodness of fit measures.

6. THE IMPORTANT COMPONENTS OF MANAGERIAL ABILITY COMPETENCIES

To develop training packages to improve farmers' managerial ability it is clearly critical to decide on the competencies that make up ability in total. To assess what farmers believe are the important competencies a mail survey was carried out in which the farmers were asked to rank a wide range of possibilities. These sets of possibilities were grouped into subsets called 'managerial attributes', 'entrepreneurial skills', and 'personal attributes'. Appendices C, D and E contain the list of statements which the farmers were asked to rank on a 1 to 7 scale. The average ranking for both the farmers and a sample of consultants (NZ Institute of

Primary Industry Management members) is given, as well as the overall importance ranking.

The overall impression from the rankings is that the farmers believe a wide range of skills are important for efficient management. This would be expected given the diverse nature of the elements that in total go to make up agricultural production. However, this wide range, which both the farmers and consultants largely agree on, is not particularly helpful when it comes to deciding on what skills to concentrate on for training purposes. Consequently, all the possible attributes as exhibited by the 'statements' in all three groupings with a score of at least 5.7 were combined and factor analysed. The results are given in Table 2.

TABLE 2: FACTOR ANALYSIS OF COMPETENCIES FROM ALL GROUPS WITH A SCORE GREATER THAN 5.7*

<u>Competency</u> (paraphrase)	FACTOR LOADINGS		
	<u>Factor One</u>	<u>Factor Two</u>	<u>Factor Three</u>
Observing current state of farm		0.6	
Planning for short and long terms	0.5		
Obtaining planning information	0.6		
Intuitively noting early signs	0.6		
Acting on time	0.6		
Negotiation skills	0.6		
Looking ahead and anticipating	0.7		
Good risk management	0.7		
Early observation of important factors		0.7	
Keeping a cool head		0.7	
Confidence to conclude and act		0.6	
Learning from experience		0.6	
Developing a good character			0.6
Understanding interrelationships		0.6	
Getting cooperation of employees/contractors			0.6
Successful judge of personality			0.8
Resolving conflicts			0.8
Good relationships off the farm			0.6

* only loadings of 0.5 or greater are displayed

The factors all had eigenvalues greater than one, and explained 54% of the variance with a very high level of significance ($p < 0.001$)

It is clear factor three is about good skills in selecting and managing people. Factors one and two are more complicated and involve several competencies. Factor one is about planning and associated issues such as information gathering and risk management. It is also about effective implementation of the plans – looking ahead and anticipation, intuitively picking up important signs, successful negotiations and

acting on time. Summarising – it is about planning, implementing and control. Factor two is similar and really reinforces the implementation component of factor one through early observation skills, keeping a cool head, confidence to decide and act quickly, learning from experience and understanding all the interrelationships between the components of any system.

These results provide a strong message on the farmers' views of what constitutes the skill components of good management. Furthermore, these components are relatively stable across different sectors of the primary producing industry as it was shown the rankings change very little with age, education, farm type, managerial style, gender, profit objective variations and computer ownership. The challenge is to develop effective and readily available training packages that will improve these important skills. This is in contrast to developing management aid decision models which, to date, have not found the success that many would have hoped for despite the significant investment worldwide in such models (McCown, 2002; Gelb et al, 2001; Nuthall, 2004. Also note that despite this situation, decision aids, or decision support systems (DSS), continue to be developed in all parts of the world. For example, see Detlefsen and Jensen, 2004; Tedeschi et al, 2004; and Castelan-Ortego et al, 2003). Improving management skill can be achieved in a number of ways, each of which involves training and education in its various forms. Indeed, there is ample evidence that farmers' education level is correlated with change and achievement (see, for example, Ondersteijn et al, 2003). Further, working with farmers (the participatory approach – Leeuwis and Pyburn, 2002) is also valuable.

7. AN OUTLINE OF A FARMER ORIENTED COMPUTERISED TRAINING PACKAGE TO ENHANCE THEIR MANAGERIAL SKILLS

One of the potential advantages of using computerized packages is the relatively low cost per farmer compared to people-orientated approaches. However, to be effective the package must be seen by farmers to be significantly beneficial and simple to use. If the package can also provide challenges, inherent interest, and, on successful completion, an educational certificate they are more likely to be used. Including well-constructed management games as a component is also likely to be beneficial both from educational and interest perspectives.

In line with these views an extensive interactive package was developed. It has some 60 modules based on a menu system. In line with the important competencies the three core modules cover **observation, anticipation and risk management**. While one of the competency factors involves people management, this aspect was not included in the package as there already exists many training programmes in this area. Management clearly starts with observing the current state of the farm, markets, technology, and so on. Secondly, plans must be made and this involves successful anticipation of possible outcomes to enable selecting the most appropriate. Finally, as production occurs in a risky environment, plans and actions must allow for the chance impacts.

The list of skills covered is reflected in the submodule names. These are listed below:

Overview	Introduction-vision capture	Asset structure
Course instructions	SWOT and time lines	Flexible system and resources
Observation outline	Budgets	Knowledge and information
Recent observations	Review-vision capture	Using the tax system
Reality check (your farm)	Introduction-practicality	Types of risk
Visual observation	Project management and CPA	Calculating probabilities
Reading observation	Monitoring; control and rules	Comparing alternatives
Objectives and skills	Getting the sums right (economics)	Estimating probabilities
Memory growth	Conclusion and ACTION	Ideas for improvement
Problem definition	Time management	Alternative comparisons
Deciding relevance	Feed management	Hay management skills
Record keeping	Ant. Exercise one	Quizzes and tests
Listening skills	Ant. Exercise two	Management style
Obs. Exercise one	Time management exercise	Magagement aptitude
Obs. Exercise two	Talking feed	Control belief
Process practice	Calculating feed	Biases in decision making
Review-observation	Introduction-risk	Probabilities and chances
Introduction-anticipation	Your situation and management	Reducing risk
Introduction-creativity	Measuring risk	Multi-choice .. risk
Areas to consider	Sources of risk	Risk attitude
Rolling out imagination	Attitude to risk	Test one
Approaches to thinking ahead	Introduction-options	Test two
Futures approach	Insurance	Reading
Retirement planning	Diversification	Multi-choice .. observation
Review-creativity	Contracts	Anticipation .. general
Introduction-visualisation	Low variability products and methods	Multi-choice .. anticipation
The farm totality		List of helpful items
Review-visualisation		

To give a snapshot of the package several representative screens have been captured and presented in Appendix F.

The package keeps track of the hours the user spends on each module, and also records the scores on all tests and quizzes. Every time the user starts up the package reminds the user of what tests and tasks still need completing. The system also requests users to make summary notes of each module which are stored for future review.

So far the response from testing farmers has not been as positive as might be expected. They have been encouraged to self monitor their use of the package, but it would seem it would be better to have a formal tutor that checks on progress, perhaps in locally based group sessions. This approach has yet to be tested. In the end the success of the package can only be judged on whether the farmers' skills improve. This testing will take several years. The package contains the psychometric tests outline in this paper, as well as other question sets designed to encourage the farmer to keep sensible records of her/his operations.

8. SUMMARY AND CONCLUSIONS

Primary producers, and managers in general, are constantly making decisions of various degrees of importance. Many of the decisions are intuitively based in contrast to being formally researched and assessed. Some farmers make more appropriate decisions than their colleagues as reflected in the variable outcomes. It would be extremely useful to be able to understand the reasons for the difference, and to be able to predict their recurrence. Such information would help working with farmers in improving their intuitive skills as it is clearly not possible to constantly provide support, nor would it be desirable. This is in contrast to providing technical information which is also an important aspect.

This discussion has provided details of three tests designed to predict aspects of a farmers' managerial operation, and reports on the results of analysing survey data of a random selection of New Zealand farmers from all farm types and locations. The answers from the tests provide benchmark information against which individual farmers' responses can be related and compared. These results can then be used as a basis for discussion with farmers over aspects of their management that might need changing.

While the managerial style and locus of control tests are simple and well founded, the managerial aptitude test was not as successful in that its apparent ability to predict outcome success is not nearly as good as would be hoped. Considerably more work is required in this area, particularly with regard to formally evaluating a farmers' experience and the lessons learnt. The data from the surveys has also been used to explore what can be called 'the origins of managerial ability'. How much of a farmers' genetic makeup determines his or her ability? How important is the formal education, or perhaps the particular experiences encountered? The initial results are tending to suggest that early experiences are critically important. If this turns out to be correct, then any test used for predicting ability must somehow measure the degree and type of experiences as well as the absorption of the lessons presented by the experiences. The test used does not seem to provide this.

The culmination of this exploration of farmers' attributes and the basis of their managerial skill is the development of training programmes to modify and improve their skill. Details of a farmer oriented package was presented. Tests to date, however, have not been as encouraging as was hoped. It is likely that the idea of a self monitored package is false, leading to the need to have a tutored approach. This has yet to be developed.

This work is ongoing with a view to providing better tests and procedures for helping future managerial ability training.

REFERENCES

Amos (Arbuckle, J.L. & Wothke, W.) version 4 (1999). *Users Guide*, Small Waters Corporation, Chicago.

Castelán-Ortego, O.A., Fawcett, R.H., Arriaga-Jordon, C., and Herrero, M. (2003). A decision support system for smallholder campesino maize-cattle production of the Toluca Valley in Central Mexico. *Agricultural Systems* 75(1):23-46

Das, M., Mpofu, Dunn & Lanphear. (1998). Self and tutor evaluations in problem-based learning tutorials: Is there a relationship? *Medical Education* 32:411-418.

Detlefsen, N.K., and Jensen, A.L. (2004). A stochastic model for crop variety selection. Agricultural Systems 79(2):171-204

Fitzgerald, J.T., White, C.B., & Gruppen, L.D. (2003). A longitudinal study of self-assessment accuracy. *Medical Education* 37:645-649.

Gelb, E.M., Parker, C., Wagner, P., Roszkoph, K., (2001). Why is the ICT adoption rate by farmers still so low: Summary of the EFITA 2001 Conference Questionnaire and Symposium. EFITA papers. Available from www.efita.org

Gramzow, R.H., Elliot, A.J., Asher, E., & McGregor, H.A. (2003). Self evaluation bias and academic performance: Some ways and some reasons why. *Journal of Research in Personality* 37:41-61.

Leeuwis, C., and Pyburn, R., (Eds) (2002). *Wheel-barrows full of frogs: Social learning in rural resource management*. Koninklijke van Gorcum, Asses, The Netherlands.

Matthews, G. and Deary, J. (1998), *Personality Traits*. Cambridge University Press, Cambridge.

McCown, R.L. (2002). Locating agricultural decision support systems in the troubled past, and socio-technical complexity of 'Models of Management'. *Agricultural Systems* 74(1):11-25

Miller, D., Kets de Vries, M.F.R., Toulouse, J-M., (1982). Top Executive Locus of Control and Its Relationship to Strategy Making, Structure, and Environment. *Academy of Management Journal* 25(2):237-253

Millet, P. (2005) *Locus of Control and its Relation to Working Life: Studies from the Fields of Vocational Rehabilitation and Small Firms in Sweden*. Dept. of Human Work Science, Lulea University of Technology, Sweden.

Nuthall, P.L. (2004). Case studies of the interactions between farm profitability and the use of a farm computer. *Computers and Electronics in Agriculture* 42:19-30

Ondersteijn, C.J.M., Giesen, G.W.J., and Huirne, R.B.M. (2003). Identification of farmer characteristics and farm strategies explaining changes in environmental management and environmental and economic performance of dairy farms. *Agricultural Systems* 78(1):31-55

Sternberg, R. J. (1988) *The Triarchic Mind: A New Theory of Human Intelligence*. Viking, New York

Tedeschi, L.O., Fox, D.G., and Guiroy, P.J. (2004). A decision support system to improve individual cattle management. *Agricultural Systems*. 79(2): 171-204.

APPENDIX A: MANAGERIAL STYLE QUESTION SET

Question Set (scored on a 1 to 5 scale of truth)	Results From 700 Farmers' Responses						
	Mean Score	Contribution of Each Question to Each Factor					
		1	2	3	4	5	6
1. You tend to mull over decisions before acting.	2.2				.5		
2. You find it easy to ring up strangers to find out technical information.	2.5						
3. For most things you seek the views of many people before making changes to your operations.	3.0				.8		
4. You usually find discussing everything with members of your family and/or colleagues very helpful.	2.1				.6		
5. Where there are too many jobs for the time available you sometimes become quite anxious.	2.7	.7					
6. You tend to tolerate mistakes and accidents that occur with employees and/or colleagues.	3.0					.7	
7. You share your successes and failures with colleagues.	3.2						
8. Keeping records on just about everything is very important.	2.5						
9. You admire colleagues who are financially logical and don't let emotions colour their decisions.	2.2		.4				
10. You sometimes don't sleep at night worrying about decisions made.	3.4	.7					
11. You find investigating new approaches to your work exhilarating and challenging.	2.1		.7				
12. You tend to write down options and calculate monetary consequences before deciding.	2.2		.5				
13. You tend to worry about what others think of your methods.	4.1	.6					
14. You are happy to make do with what materials you have to hand.	2.5					.4	
15. You find talking to others about practiced/professional ideas stimulates and excites you as well as increasing your enthusiasm for new ideas.	2.0		.6				
16. Having to make changes to well established management systems and rules is a real pain.	3.3		-.5				
17. You normally don't rest until the job is fully completed.	2.3		.6				
18. You normally enjoy being involved in professional organisations.	3.1			.8			
19. You sometimes believe you are too much of a stickler for checking and double-checking that everything has been carried out satisfactorily.	3.3		.5				
20. When the pressure is on you sometimes become cross and short with others.	2.6	.6					
21. You generally choose conclusions from experience rather than from hunches when they are in conflict.	2.0						
22. You are inclined to let employees/colleagues do it their way.	3.1					.7	
23. You not only speak your mind and ask questions at professional meetings, but also enjoy the involvement.	3.0			.8			
24. It is very important to stick to management principles no matter what the pressure to do otherwise.	2.8		.6				
25. You are much happier if everything is planned well ahead of time.	2.0		.6				

APPENDIX B: LOCUS OF CONTROL QUESTION SET

For each of the following statements indicate how true it is. Each statement has five boxes beside it – tick only the ONE that best describes your degree of belief in the statement.

1. So far I have managed to largely achieve my goals.
2. I never try anything that might not work.
3. I'm using exactly the same production methods that I have used for many years as they have stood the test of time.
4. It's no use being stubborn about a job or management approach that doesn't initially work.
5. I reckon 'good luck' doesn't exist – 'luck' is really good management, and 'bad luck' poor management.
6. It is safer not to rely on others to get the job done well and on time.
7. I'm able to get others to do the jobs my way.
8. Too often I end up having to run my property to suit others' demands.
9. While being a good manager involves some training, experience and reading, management skill is mainly determined by your genes.
10. You can work hard at creating good relationships between neighboring managers, but often your efforts fall on deaf ears as people are commonly uncooperative and self-interested.
11. I find most employees work hard and finish the tasks set very adequately after a bit of training where necessary.
12. The years when the property has shown poor production and profit have been due to circumstances totally out of my control.
13. In local body affairs it's easy for a hard working and dedicated individual to have an impact in getting changes for the better.
14. Often I get frustrated as circumstances beyond my control impede the smooth progress of my management plans and decisions.
15. Some people seem to be just lucky and everything works out for them, but it hasn't happened to me much.
16. I tend to carefully plan ahead to ensure my goals are achieved, and often do budgets and commit my ideas to paper.
17. I seldom change my management and production systems unless I'm doubly sure the change will be positive. So much depends on chance.
18. When things go wrong it is so often due to events beyond my control – the weather ruins the hay, the wool auction I choose has a sudden price dip,
19. When I know I'm right I can be very determined and can make things happen.

APPENDIX C: IMPORTANCE OF MANAGERIAL ATTRIBUTES

Mean Scores on a 1-7 Scale (not ... to ... very important)

(order)	Farmers	NZIPIM	(order)
1. Being up-to-date with the current condition of the property in its totality (bank balances, animal condition, crop growth, soil moisture, feed levels, machinery repair)	6.23	6.07	(3)
2. Ability to identify the key factors in a problem and discard the irrelevant	6.16	6.29	(1)
3. Making requirements clearly understood (effective communication).	6.13	6.28	(2)
4. Assessing job priorities	5.93	6.00	(4)
5. Quickly analysing and sorting out situations that have never been faced before	5.68	5.26	(12)
6. Having a clear understanding of the family's objectives, values and goals, thus making assessing the value of alternative actions easy.	5.67	5.79	(5)
7. Picturing (understanding) the consequences of a decision over the many (or few) months/ years it might impact over (e.g., planting an area in forestry, subdividing a paddock).	5.63	5.71	(7)
8. Being able to efficiently organise and carry out quite complex operations (e.g., get a new packing shed operational on time)	5.61	5.52	(8)
9. Developing appropriate and detailed plans for both short and longer term horizons.	5.47	5.71	(6)
10. Understanding the basis on which to choose between alternatives (e.g., knowing how to cost unpriced labour, knowing how to do gross margins, understanding diversification principles).	5.31	5.32	(11)
11. Skill at keeping, interpreting and using recorded data about the property and associated factors (e.g., market trends).	5.17	5.42	(10)
12. The ability to predict product prices into the foreseeable future, or at least understanding the factors that determine the prices, and understand market requirements.	5.16	4.96	(13)
13. Developing and maintaining a support network of colleagues and professionals.	4.89	5.44	(9)
14. Being able to predict local weather better than the official forecaster.	4.23	3.07	(15)
15. Understanding the local political scene as it might impact on rules affecting what can be done.	3.88	3.40	(14)

An analysis of variance showed the differences between the means was highly significant with $F = 199.05$ ($F = 236.45$ for NZIPIM).

APPENDIX D: IMPORTANCE OF ENTREPRENEURIAL SKILLS

Mean Scores on a 1 (not important) to 7 (very important) Scale

(order)		Farmers	NZIPIM	(order)
1.	Understanding deadlines and being able to ‘act in time’ (e.g., spray before insect damage, fertiliser applied in good time).	6.16	6.38	(1)
2=	An ability and determination to look/ask/seek out information thought to be necessary for making decisions.	5.78	5.99	(2)
2=	The skill to negotiate the best possible deal (price, arrangement).	5.78	5.34	(9)
4=	Understanding sources of risk and what can be done to reduce its impact.	5.75	5.70	(4)
4=	An intuition that gives early warning signs when something is not right, or, in contrast, when something positive needs exploiting.	5.75	5.65	(6)
6.	Ability in learning new skills.	5.58	5.71	(3)
7.	An ability to look ahead and anticipate likely problems, needs, and opportunities.	5.70	5.61	(7)
8.	When faced with opportunities, ensuring ALL alternatives are sought out, considered and evaluated.	5.65	5.35	(8)
9.	A belief in being able to control a lot of what happens around the property in contrast to a belief that not much is really controllable due to the weather, markets, government action	5.55	5.69	(5)
10.	Skills in finding the very best market (price, quantity) for all output.	5.34	5.03	(11)
11.	Being able to seek out, identify, and clarify new opportunities (production, products, marketing).	5.21	5.25	(10)
12.	The skill and intuition to forecast well into the future likely opportunities in products and production systems.	4.90	4.68	(12)

APPENDIX E: IMPORTANCE OF PERSONAL ATTRIBUTES

Mean Scores on a 1 (not) to 7 (very important) Scale

(order)	Farmers	NZIPIM	<u>(order)</u>
1. Early observation of important indicators around the property (e.g., lambs are scouring, wheat is infected, cows losing weight, pasture growth has increased.....)	6.65	6.72	(1)
2=. Ability to learn from experience, mistakes, and failures.	6.35	6.28	(2)
2=. Developing a 'good moral character' involving openness, integrity, reliability, trustworthiness ...	6.35	6.10	(3)
4=. Maintaining good relationships with outside people - bankers, accountants, suppliers	6.19	5.87	(6)
4=. Keeping a cool head and putting aside any tendency to panic when faced with stressful situations.	6.19	5.79	(7)
6. Having the confidence to draw conclusions and act quickly and decisively.	6.18	5.95	(4)
7. Obtaining employees and/or contractors co-operation and understanding leading to harmonious and productive relationships.	6.08	5.91	(5)
8. Understanding the inter-relationships between all the components of the property (e.g., rainfall - soil moisture - plant growth - animal grazing i.e., what affects what?).	5.99	5.77	(8)
9. Successfully resolving conflicts on, and off, the property (e.g., dispute between employees)	5.78	5.57	(10)
10. Successfully judging personality and selecting suitable employees.	5.74	5.53	(11)
11. An excellent knowledge of facts, figures, procedures and methods, with respect to soils, plants, animals, machines, buildings.	5.58	4.99	(12)
12. Accepting the good and the bad and not letting it affect management and decision making.	5.53	4.93	(13)
13. High motivation in constantly seeking better ways and implementing them; in contrast to being happy with current systems.	5.28	5.75	(9)
14. The determination to keep working all hours until the high priority jobs are completed.	5.24	4.48	(15)
15. Being prepared to give it a go and take risks in changing production systems and/or starting new ventures.	5.14	4.84	(14)
16. Developing a strong personality so that others 'sit up, notice, respect, and act' on what is said.	4.96	4.27	(17)
17. Tertiary education in areas related to primary production (agriculture, horticulture, biology, marketing)	4.61	4.33	(16)
18. Having above average intelligence and school grades	4.46	4.19	(18)

APENDIX F: EXAMPLE SCREEN DUMPS FROM THE SKILL PACKAGE

The screenshot displays a software application window titled "LINCOLN UNIVERSITY IN CONJUNCTION WITH MEAT AND WOOL INNOVATIONS". The main content area features a blurred background of sheep and the large text "MANAGERIAL SKILL DEVELOPMENT FOR FARMERS". At the bottom of this area are two buttons: "Menu" and "Finish".

Below this is a Windows taskbar showing the "Start" button, several open applications including "Exploring - C:\", "KnowledgePro Gold", and "LINCOLN U...", and a system tray with the time "03:27 pm".

The main application window has a menu bar with the following items: "EXPLANATION", "RISK MANAGEMENT", "OBSERVATION SKILLS", "ANTICIPATION SKILLS", "ASSESSMENTS", "HELP", and "FINISH".

The active window is titled "Low variability products and production methods..." and contains a sub-window titled "Enter your data for irrigation calculations". The sub-window has a yellow background and contains the following text and form fields:

IRRIGATION CALCULATIONS
Enter the data and let the system do the calculations for you...
Using your best estimates [some of which you might not be that confident about but we need to start somewhere .] answer the following:

- What area(has) could you irrigate?
- What do you think the total capital cost(\$) would be?
- What is the current borrowing interest rate(%)?
- To irrigate the max area what are the likely total running costs?
- What would be the cost/ha of any extra fertilizer used?
- What is your current lambing % survival to sale or replacement?
- What is the difference between best & worst years lambing%?
- With irrigation what lambing % expected?

Low variability products and production methods....

assured wool growth
 assured lamb finishing perhaps
 assured lambing % through assured flushing and ewe body
 weight maintenance.

All these add up to a more assured cash surplus.

Of course, in some cases, the irrigation may possibly be

The results of the irrigation estimates

COMPARISON	WITHOUT IRRGN	WITH IRRGN
AVE GROSS(\$)	221637	285055
HIGHEST(\$)	234850	289939
LOWEST(\$)	208425	280171

OK

msanal02 The results of the irrigation estimates

If you can get N fertilizer onto at least part of your farm
 here's
 a story worth reading

MORE SUGGESTIONS ON REDUCING PROFIT VARIABILITY

A special case of a 'production system' with low variability
 used by many people is the use of high levels of FEED RESERVES
 (hay, and/or silage which keeps for many years if made well).

Sorting out what records to keep

THE VIRTUES OF KEEPING RECORDS

[One of the more important observation skills]

You undoubtedly already keep records. As our memories are not perfect we all keep some records, even if only for the tax department. But, in most cases, we should keep rather more. In general, records, as indicated, are necessary for tax purposes, but also as a base for good decision making, and to satisfy our curiosity about what is happening. These curiosity records may be important to provide enjoyment from our farming activities.

Individuality, and the records you should keep: as we all have different requirements and abilities, the system that is best will be somewhat unique to your farm. If working out a system, consider the time and cost involved relative to the value [from better decision making] of the records.

Data is NOT information: you need to convert the raw data collected into useful information that can be used as a basis for decisions. Records, for example, on expenses and sales, need to be added up and related to individual activities [eg the cattle enterprise, the feed costs per sheep...] so you can then

Sorting out what records to keep

The case of Jack and Jill. Given your particular habits, aptitudes, memory skill (be sure to use the memory module to enhance your memory skills), and farming situation, there will be a record keeping setup that is best for you. It must be practical, useable, and useful. What Jack and Jill do might give you some ideas. They run a lamb finishing property in the variable rainfall east coast on rolling hill country. The property could be bigger, so they manage very carefully to squeeze out a sustainable living. And they do it adequately, though a series of droughts would put extreme pressure on their finances. What records do they keep?

What Jill does

What Jack does

How Jill and Jack use their system

Reviewing your system - a check list: it is useful to go through a list of possible records and think whether each one might be useful to you. The list includes personal records, `other person provided` printed material, material on price and cost expectations, as well as historical figures, farm records, through to cash flow and tax records.

Record keeping in a nutshell: satisfy legal requirements, and create/keep records where the value of their use exceeds the

Developing skills for imagining the future, and creativity....

LETTING THE THOUGHTS AND IMAGINATION ROLL

Thinking ahead (anticipation) requires imagination.
A good manager must be good at this, not just simply repeat what everyone else does, and has done. Follow the rules below....

RULE 1 Ignore practicality.

- at lease in the first instance do not be constrained by what you think will work, or will be practical. (Some people are too practical for their longer term good).

RULE 2 Record your ideas without fail.

Always jot down on a piece of paper your ideas or images. Perhaps even in your diary, or preferably a special notebook to record these ideas (you are bound to loose scraps of paper!). Buy one TODAY.

EXERCISE

Some of the cheapest land is found in drought prone areas. Take a scrap of paper and