

**MANAGERIAL ABILITY
(THE FORGOTTEN RESOURCE)
ITS ASSESSMENT AND MODIFICATION**

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ABSTRACT

Survey information in most countries shows very clearly that farmers achieve a wide range of profitability levels. Some of the variation will be due to farmers having different goals and objectives, but a significant proportion will also be due to variations in managerial skill. If even modest skill improvements can be achieved the resource efficiency payoff will be significant and at little cost relative to many physical research programmes - this goal is worth seeking. Managerial skill improvement has received little attention in the past.

Standard teaching methods can probably help to a certain extent, but many skills may be deeply imbedded thus requiring different methods. Evidence from cognitive therapy papers suggests basic traits can be modified, so why not managerial attributes similarly? This paper reviews the work on cognition and personality that may be helpful, and also considers the competencies that constitute the components of good management. It is clear from the work on the psychology of decision making and judgement that many biases in a range of decision areas are common. The opportunity for exploring ways of removing these biases and improving managerial ability would seem to be ripe for the picking. This will involve developing psychometric tests for each competency and the development of competency enhancement programmes.

The work on personality assessment and change will be reviewed to assess whether the same principles can be used in the management area. The paper contains more questions than answers, but will provide considerable food for thought.

1. INTRODUCTION

Managerial ability has always been regarded as an important parameter in agricultural production. While there have been studies on descriptive aspects of management processes and abilities (e.g., Johnson et al (1961)), few studies have focussed on developing methods and procedures for improving the level of individual manager's abilities. Managerial skill is almost a forgotten resource. This review is designed to appraise the background to managerial ability, particularly with respect to the relevant psychological research, and to consider what is necessary to develop programmes for improving ability and associated research programmes.

There is a modicum of interest in the management factor and its psychology starting to appear. Ohlmer et al (1998) developed concepts of the steps Swedish farmers used when making decisions - this work was a useful and timely start. Rougour et al (1998) looked at measuring management capacity and noted 'explicit definitions (of management capacity) together with an elaboration of the concept are hard to find'. They introduced the notion of psychological aspects being important and reviewed efficiency studies- they noted the next stop would be to include 'aspects of the decision making process'. Clearly the seeds have been set.

While not in regard to managerial ability, Willock et al (1999), and others, report on a study which measures and highlights many psychological variables of Scottish farmers. While this study did not involve managerial ability it has provided a valuable backdrop and experience for such studies, particularly with regard to quantifying the relationships (Austin et al (1998)).

Mention managerial ability and many beliefs and theories will be voiced. Preston (1996) is reported to have said farming success depends on hard work both 'with the brain and physically', timing - 'everything is done when it should be', and achieving 'consistently good figures, such as gross profit per stock unit, lambing percentage and wool weights'. Some might argue with these statements, but the real point is that managerial ability revolves round rather more fundamental issues that eventually give rise to some of these more obvious traits. This is where study is required.

Currently very few farm managers obtain any management skill training other than through 'on the job' experience. Even the increasing numbers graduating from tertiary institutions (in New Zealand 27.2% of farmers have had tertiary education (Nuthall and Benbow (1998)) do not have exposure to other than a few theoretical aspects of ability. This would seem an area for rewarding development.

3. A MODEL OF MAN'S MODUS OPERANDI

Each person is born with certain attributes (genotype) and eventually evolves into an individual with certain observable characteristics (phenotype). Thus, the genotype combined with the environment gives rise to each manager. The manager is exposed to \times cues \Rightarrow , observes some, processes them and subsequently acts, sometimes appropriately, sometimes not so appropriately. The major question is whether, for any individual, the appropriateness of the action can be improved. This implies there is some kind of measuring stick (see the later section on goals).

A person, it seems, has \times traits \Rightarrow and \times states \Rightarrow . The traits are the stable components, whereas the states (moods) vary from time to time. Furthermore, traits can be broadly grouped into personality, intelligence and, possibly, motivation. A review of the literature suggests psychologists are by no means in agreement with this brief summary, but there is a tendency in this direction.

Personality is made up of several components (traits) with many studies concluding that there are probably five basic traits. The most recent review (Matthews and Deary (1998)) lists these as:

Neuroticism	- anxiety, angry hostility, depression, impulsiveness, vulnerability
Extroversion	- warmth, gregarious, assertiveness, and positive emotions
Openness	- fantasy, aesthetics, feelings, action
Agreeableness	- trust, straightforwardness, altruistic, tender mindedness
Conscientiousness	- competence, order, dutifulness, self-discipline, deliberation

Deary also reports on the many twin studies to assess the importance of genotype and the environment. It appears for extroversion the genetic contribution is of the order of 56-70% in women, and 54-80% in men. Overall, however, they conclude that the genetic contribution is about 36% with 12% being determined by the shared environment (of twins), and the remainder determined by the unique environment experienced. If true, the environment is a powerful modifying factor in determining the managerial component of the phenotype.

Intelligence is clearly another important trait in managerial ability. Psychologists have a range of views on the components of intelligence, but generally agree that at least two components are important - \times fluid ability \Rightarrow (broad basic reasoning ability) and \times crystallised ability \Rightarrow (fluid ability as it is expressed in a particular culture). Horne and Cattell (1966), as reported in Kline (1993), further define intelligence using the following variables.

g_f = fluid - loading onto inference, induction, memory span, flexibility of closure, intellectual speed.

g_c = crystallised - loading onto verbal, mechanical, numerical and social skills.

g_v = visualisation - loading onto spatial, orientation, form.

g_r = retrieval capacity.

g_s = cognitive speed factor.

Besides personality and intelligence some psychologists believe motivation is a basic trait, but there is less agreement on this particularly as motivation is difficult to measure with dynamic changes occurring from period to period. Kline (1993) believes the distinction between personality and motivation is somewhat arbitrary so perhaps aspects of motivation slip between >trait= and >state= classification.

A further question in a >model of man= is whether s/he is, or wants to be, rational, which also raises the question of objectives or goals, which also introduces a persons= attitude to risk. Abelson and Levi (1985) provide a useful and extensive discussion on the rationality question, but do not venture into providing a strong evidence-based conclusion. They hint at a tendency towards believing in the existence of rationality. They also note (p 234) Athe common sense view of the major cause of irrationality, when it occurs, is that people fall into the grip of emotional or motivational forces they cannot, or will not, control@@complimentarily - general motives such as the enhancement of self esteem, the management of the impression one makes on others, and the avoidance of anxiety, might produce well organised and systematic violations of normative standards@ If man is not rational with respect to definable goals then developing systems and processes to improve the management of limited resources loses much of its reason. Few would accept this tenant.

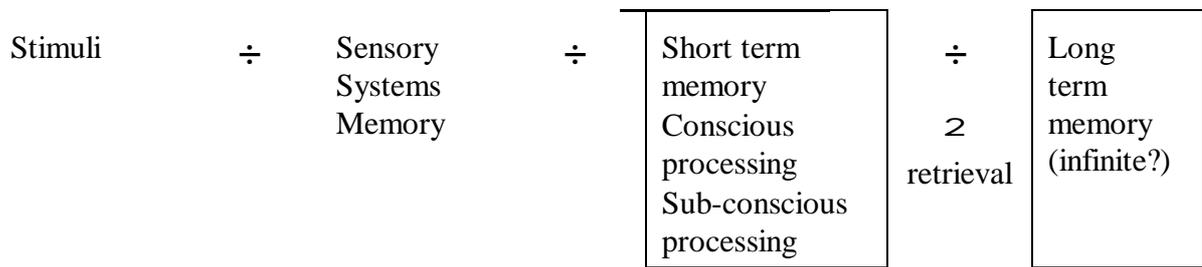
Given then, a relatively rational human being endowed with a potentially definable genetic makeup and a set of experiences culminating in a particular personality, intelligence and motivation endowment, this >construct= will respond in various ways when exposed to stimuli. Such stimuli can range from a loud noise to a complex set of price signals. The >person= holds her or his total psyche in a brain which in very simple terms has a memory and processor in much the same way as a computer.

Memory is thought to consist of short and long term components (Eysenck & Keane (1990)). Initial observations are held in short term memory, are processed in the same area, and are then transferred to long term memory if thought to be of significance. Short term memory capacity, and thus processing capacity, is thought to be limited. In contrast, long term memory is virtually limitless.

Eysenck & Keane (1990) discuss in some detail the whole process of observing, learning, recording and responding. While there are many theories, one plausible schema includes the notions that humans create mental models or pictures of situations rather than using abstract procedures. Solutions and approaches are stored as schema (chess masters hold patterns that are used to make moves in contrast to logically sorting each move - thus experience is important), the subconscious holds and controls many learnt skills automatically (e.g., bike riding), the subconscious also holds many learned emotions and, finally, the many aspects of our beings stemming from environmental influences are absorbed in the formative years and

are difficult to subsequently change.

A diagrammatic summary might resemble the following:



Some workers believe a person's psyche is embedded in what Kelly (the inventor) called 'constructs' (Salmon (1980)) - Kelly believed 'man' is constantly striving to make sense of the world through actively setting up hypotheses and putting them to experimental test. Those that work for the individual become 'constructs' - essentially they are rules by which to operate. These constructs are in a continuous state of change resulting from new experiences.

4. DECISION PROCESSES AND ACTION

Nickerson and Fehrer (1975) conclude decision making involves

- information gathering
- data evaluation
- problem structuring
- hypothesis generation
- hypothesis evaluation
- preference specifications
- action selection
- decision evaluation

Throughout the literature many variations on this process list can be found. What is crucial is that these steps, or their variations, are logically and rationally followed. In reality this is seldom the case. This section considers the process in general and presents information on the psychology of the various steps and, most importantly, biases that tend to modify the rationality of the process.

Nickerson (1994) notes problem solving involves induction and deduction, and the development of a path through problem space - at each point there is a need to respond to the mental representation of the problem though there is a limit to working memory so the representation may need to be simplified. To overcome this problem schemata are developed, thus shifting some of the problem to long term memory. Thus the importance of the discussion in the previous section becomes more apparent in understanding the process. In real world situations, which tend to be dynamic, the complexity means seldom is it possible to face a new problem and produce a totally rational and complete decision process. Experience

and repetition are important (Brehmer (1990), Slovic et al (1977)) as are the correct observation of the relevant cues in the first place (Stevenson & Naylor (1990)).

The decision process is started through some form of problem recognition - Abelson and Levi (1985) suggest decision makers monitor whether there is a discrepancy between the existing and desired states. Accumulating stimuli must reach a threshold level before problem recognition occurs - information gathering and the isolation of alternatives then starts. Of course, problems might be occur when it is recognised new opportunities have been observed in some way even though a problem in the traditional sense has not be isolated. Success at problem recognition is clearly crucial to good managerial ability (Weber (1994)).

A conclusion is reached when the choice process is implemented and an action defined. Abelson and Levi also review choice systems, and possibilities. Many theories exist - examples include simply going down the alternatives until an acceptable one is found, or not choosing until all alternatives have been considered - this introduces the question of goals and objectives which will be covered in more detail in a later section.

The dynamic nature of most decision situations is a complicating factor. Thus, not only must the correct choice be made but they must also be made in the correct sequence and at the right time. Little research has been conducted on dynamic problems, (Stevenson et al (1990)), but one worker, Brehmer (1990), developed simulation models to study the problem and stressed the value of experience. Indeed, there is evidence that heuristics are a common decision procedure - these are decision systems and guidelines developed form past experience.

Many people make decisions in complex situations without an apparent formal process, and certainly cannot explain how they achieve the outcome. Cook and Stewart (1975) compared subjective/intuitive processes with statistical measures and found few outcome differences. Broadbent et al (1986) found decision makers can learn to improve their performances without actually knowing why. The experience has provided lessons absorbed by processing and memory systems. This whole area of subjectivity and intuition has been little studied.

The study of experts, who may well develop excellent intuition, is important in considering managerial ability. Cook (1992), in reviewing expertise, quotes several authors and lists the characteristics of experts as:

1. Experts excel mainly in their own domains.
2. Experts perceive large meaningful patterns in their domain.
3. Experts are fast; and they quickly solve problems with little error.
4. Experts have superior short-term and long-term memory.
5. Experts see and represent a problem in their domain at a deeper (more principled) level than novices.
6. Experts spend a great deal of time analysing a problem quantitatively.
7. Experts have strong self-monitoring skills.

Despite the best of intentions to follow the correct processes, many decision makers look back and decide they could have made a better decision. This raises the whole area of decision biases - they are part of the human decision process. Weber (1994) talks about some of the reasons for error - objectives unknown, or unsure, alternatives not clear, too much uncertainty,

ambiguous information to process, time pressure and stress, and so on. Clearly, a decision maker should be aware of potential biases and make every effort to overcome them.

Decision makers are human and are thus influenced by emotions and stress despite the best intentions. Bohm and Pfister (1996) showed that emotions can have a significant effect on the rationality of decisions.

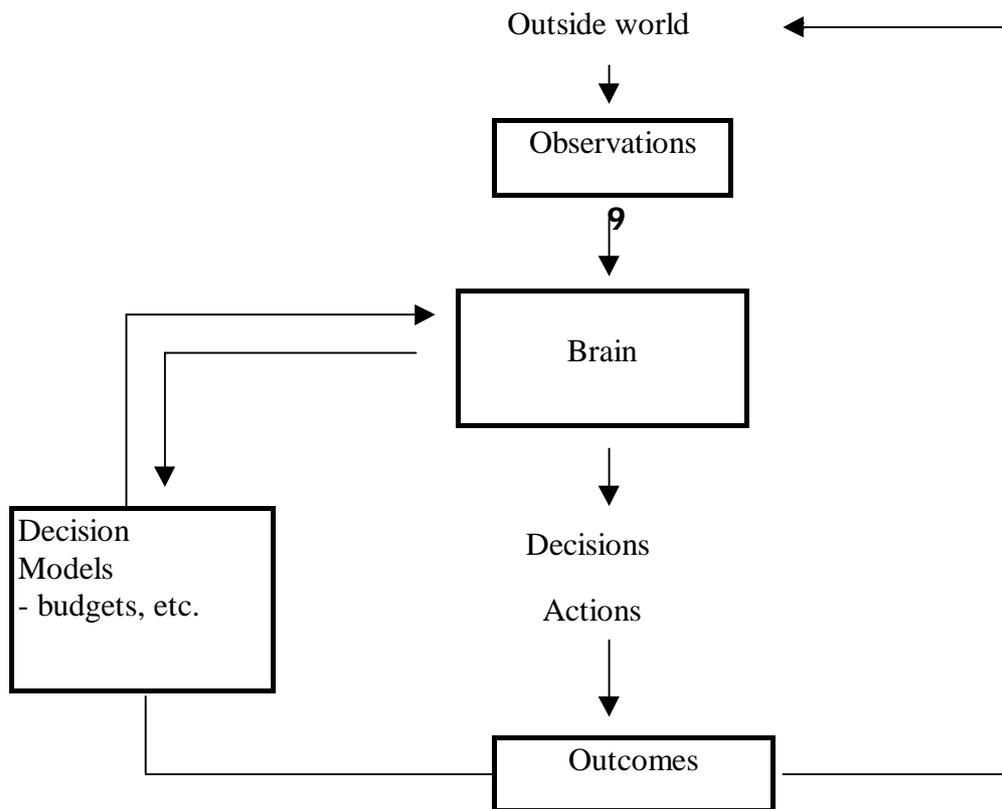
There has been a considerable amount of work on decision biases. Slovic et al (1988) and Abelson and Levi (1985) report on some of this work. Plous (1993) lists many of these in a text book, and Russo and Schoemaker (1989) produced a popular book - »Decision Traps - Ten Barriers to Brilliant Decision Making and How to Overcome Them«.

Some of the more important aspects include:

- incorrect observation of cues
- incorrect interpretation of data (framing, anchoring, vividness....)
- Incorrect probability and chance estimates (remembering only the good outcomes)
- hindsight knowledge
- belief in a lack of control (Locus on control@)
- emotional interference of rationality
- laziness - contrast between the »planner« and the »doer« in a person
- overload bias and stress
- trying to rectify the past when best forgotten

Work continues on the development and quantification of decision models and processes, particularly systems that explain how decision makers operate (see, for example, Lusk and Hammond (1991) who looked at weather forecasting using the Lens model). For an individual decision maker, what is important is recognising failure and biases and then attempting to counteract these actions. Furthermore, part of this improvement process must be effectively utilizing what aids are available.

A schematic of the decision process might look like:



Overall, it might be noted that the brain, having been endowed with a particular genotype, takes on various processes and abilities as it observes at an early age (including speech) - much of the acquisition is through trial and error as well as observation. Rules and procedures are stored and become automatic in many cases including all the irrational aspects (biases). The challenge is to devise methods of observing the biases and then removing them. Is this possible?

5. DECISION METHODS USED BY FARMERS

There is not a lot of reason to propose that farmers are greatly different from the population at large. Indeed the Edinburgh study (Willock (1997)) found farmers (Scottish) as people were remarkably similar to the population at large in terms of personality and intelligence. However, as a farmer must deal with most aspects of biology, economics, the weather, organisation, people.... they face very complex decision situations with only a bare modicum of support in an immediate office sense. A farmer's personality must be altered to some extent under this environment even though the basic underlying personality is consistent.

In one of the first, and few, detailed studies of farmer decision methods, Johnson et al (1961) found the midwest farmers followed the observation, analysis, decision action, acceptance= sequence, found their main concerns were (i) change in prices, or lack of information

concerning prices, (ii) lack of information concerning existing production methods, (iii) changes in production methods, (iv) changes in personalities, and (v) changes in economic, political and social institutions, and lack of information on existing institutions. It is unlikely these concerns have changed. They also found that price expectations were based on the standard supply model, but that farmers had naive models of people and institutions. The farmers commonly noted that they often intuitively knew when a problem existed but could not always ascertain it at an appropriately early stage. It was also found there was a correlation between education levels and a good understanding of problem solving. While farmers with higher debt carried out more analysis, levels were not high. Malcolm (1990) also concludes, in a more recent context, that farmers only use simple tools such as budgeting.

Also of relevance to altering ability is the farmer's view of how important s/he is in the control of a farm. Kaine (1994) showed the variation that exists in a sample of Australian farmers. Similarly McNairn and Mitchell (1992) found 85% of a sample of farmers in Ontario had an internal locus of control when it came to soil conservation practice. Clearly, the environment and the farmer's backgrounds will impact on how much control they believe they have.

The importance of considering farmer's processes is to ensure all aspects of managerial ability are covered. The farmer's environment is clearly very different from many production systems. Bigras-Poulin et al (1985), while considering only dairying, believed socio-psychological variables were important in achieving successful production levels. Thus, full account of the dynamic and complex situation encountered must be considered in relation to the socio-psychological situation of each farmer and her/his managerial situation. Furthermore, it is clear that the paucity of managerial process studies that have occurred needs to be rectified to balance the existing knowledge of primary production.

7. COMPETENCIES INVOLVED IN THE MANAGEMENT OF PRIMARY PRODUCTION.

Besides understanding the nature of human processes in decision making, and how they might be improved, the significant factor in improving ability is an understanding of the skills used in management. These are referred to as competencies.

A study of expert decision makers is clearly a starting point in listing the competencies, as is a search of the literature for already compiled lists. Such lists have been developed through logic and asking practitioners to consider and list the skills they use. (See Lees (1991) for a review of methods.)

Specific lists have been created by several workers. For commerce in general Page et al (1994) interviewed many groups and concluded on a forty-five component list for New Zealand conditions. A more general list was provided by Linstead (1990). For Australian educational purposes Lees (1991) interviewed groups from different farming backgrounds and produced further comprehensive lists. Salmon (1980) also produced Australian oriented lists. Rather than repeat these lists, a more general amalgam that could well be applicable to most situations has been produced. This list is:

Enunciating the objectives and goals for the totality of the farm family within the

the bounds of the group attitudes, and the dynamic life cycles.

Identifying opportunities and problems.

Ability to search out relevant information and observe appropriate material both on and off the farm.

Possessing the appropriate analytical skills and understanding economic principles - calculational, marginal analyses and opportunity cost concepts.

Ability to visualise and understand the current state of the farm in its totality, including the financial, animal, feed, crop, machinery, building and labour state details and their interrelationship implications.

Ability to visualise the consequences of decisions both independently and across all components of the farm system. Visualisation should occur through to the appropriate planning horizon.

Ability to anticipate the consequences of current events and to think ahead and act appropriately in **A**good@time.

Ability to empathise with people and successfully supervise and negotiate - an appropriate ~~person~~ and leadership personality.

Ability to satisfactorily handle stressful situations - having coping skills, and an ability to meet deadlines and time pressures using appropriate strategies.

A drive and motivation to successfully conclude relevant tasks on time. The confidence to achieve this.

Adequate office skills and competency - records, retrieving, etc.

Having appropriate technical skills and factual knowledge to complete the required tasks.

Exhibiting suitable learning skills to enable updating all competencies so they are fully valid - with appropriate speed, and an ability to learn from mistakes and similarly enhance all competencies.

Have an appropriate understanding of, an empathy with, the (i) climate and weather experienced in the relevant region, (ii) animals and plants dealt with.

8. CHANGING AND IMPROVING MANAGERIAL ABILITY

To achieve change the manager will need to want to improve, and s/he must have access to suggestions on how to change. These ~~suggestions~~ can come from a range of relatively formal course work and/or reading programs, or from working with a mentor on a more

intensive one to one way, or some combination of these extremes. The process involves improving the general competencies in contrast to simply acquiring new technical knowledge per se - this is a different process. Skill attributes are probably more deeply embedded.

To consider possible change it is useful to understand the learning process and consider past studies on its effectiveness. According to Cooke (1990), learning has three components:

- (8) Interpretative stage - factual/declarative knowledge related to the domain is learned.
- (9) Knowledge compilation - development of general purpose production rules -
 - (1) composition - putting together in chunks, understanding the structure and theories.
 - (2) proceduralization - embedding domain specific factual knowledge into production rules.
- (iii) Fine tuning - strengthening of successful production rules, weakening of unsuccessful ones.

As Eysenck and Keane point out, many decision systems eventually become internalised and thus automatic. This is acceptable if the lessons learnt are logical and correct, but if not changing these internalised rules can be difficult.

There is considerable evidence to support the effectiveness of formal training in adults with respect to a wide range of skills. Gaeth and Shanteau (1984) report on making lasting improvements to soil judges after comparing alternative training systems, Nickerson (1994) reports the quality of statistical and probability thinking processes is improved by training as was deductive reasoning. Bolger (1995), in reviewing 50 comparisons between experts and novices, concludes training has a significant effect on accuracy, but simple experience little or no effect (perhaps due to the lack of appropriate feedback?). Garb (1989) comments formally on this point - he found a correlation between training and clinical judgement, but not between experience and judgement due to the poor feedback.

Formal training is only part of the picture. Some farmers might require more detailed personal training, either because they feel they could benefit and perhaps enhance already well trained skills, or because they are having significant problems maintaining the efficiency of production at an adequate level. Such farmers may require a different approach.

Psychologist and psychiatrists have developed many theories, skills and procedures for modifying personalities and skills. There is no reason why appropriate components cannot be utilised for improving management competencies. The therapies used are designed to alter the stimuli reaction processes to ones more appropriate and acceptable to society at large. The same situation exists in decision making - some people wish to modify their decision processes to better achieve their goals.

An overview of the massive literature in psychology indicates there are many theories on how to modify thinking and action. Atkinson et al (1990) and Dobson (1988) both provide summaries of the more important theories.

It does appear that the only therapy for which there is substantiated scientifically based evidence is cognitive behaviour therapy. Thus, this section will concentrate on this approach.

There are a range of variations on cognitive behaviour therapies. Dobson and Block (1988) review many of these. They state (p 17) 'Logical errors in thinking acquired during the development period become the substance of schemata that predispose individuals to experience emotional problems'. Therapy involves replacing the distorted appraisals. The components of treatment involve teaching the recipient to (i) monitor automatic thoughts, (ii) recognize the relations between cognition, affect and behaviour, (iii) test the validity of the automatic thoughts, (iv) substitute more realistic cognition for these distorted thoughts and (v) learn to identify and alter the underlying assumptions or beliefs that predispose individuals to engage in faulty thinking patterns. It would seem logical to apply this proven process to decision making competencies.

These processes train people to be their own 'scientist' in solving personal (management?) problems. It is all about developing self regulation, self monitoring and self evaluation. D-Zurilla (1988) stresses the importance of developing 'self talk, self praise and self support' in these cognitive processes. As Dryden and Ellis (1988) point out, 'Epictetus said 'People are disturbed not by things, but their view of things''. They describe RET (Rational Emotive Therapy) and note that to change it is necessary for a person to (i) recognize they create their own 'disturbance', (ii) recognize they have the ability to change these 'disturbances', (iii) understand 'disturbance' comes from irrational, absolutest, dogmatic beliefs, (iv) detect the irrational beliefs and dispute them rationally, (v) work towards internalizing the new rational beliefs, and (vi) constantly repeat the process. For 'disturbance' the words 'management beliefs' could perhaps be substituted.

There is considerable statistically grounded evidence that cognitive behaviour therapy creates lasting and beneficial change. This evidence relates to conditions such as depression and agrophobia, so research is necessary to test the model on management competencies. Dobson and Block (1988) note the benefits for depression, D-Zurilla (1988) similarly quotes work on unipolar depression trials, Rehm and Rokke (1988) found that with constant reinforcement of appropriate attributions permanent shifts occur, and they also give reference (p 194) to treatment versus control studies that have shown significant success. Similarly, Dryden and Ellis (1988) provide (p 259) reference to the positive results of using Rational Emotive Therapy.

It would seem both appropriate formal training and specifically designed cognitive behaviour therapy could well be a significant force in improving the managerial ability of farm managers and so improve a nation's allocation of scarce resources.

9. RESEARCH AND DEVELOPMENT

The theme of the discussion is that a farmers' managerial ability can be improved. Research is necessary to develop procedures to achieve this, to compare and contrast these to isolate the most appropriate for different situations, and to ascertain the extent and type of the improvement possible. This programme has many components and will involve many years particularly as the change process would not be rapid, nor would measuring its potential success. All aspects must be quantified.

Initially it will be necessary to verify the list of proposed important competencies through interacting with farmers and associated groups (for example, farm consultants). It will then be necessary to develop psychometric tests ((Kline (1993), Loewenthal (1996)) to measure competency levels. Associated with this work must be the development of training programmes and management therapy procedures and protocols for each competency. The tests can then be used throughout the change periods to gauge success levels. In addition, throughout and beyond the treatment periods it will be necessary to monitor and gauge levels of the goals and objectives nominated by the farmers as these values must be the final arbiter in quantifying the success or otherwise of the programmes. Such data will enable comparison between the approaches.

This whole programme requires many observation measuring and questioning procedures, all related to human behaviour. The obvious place to turn for assistance is the discipline of psychology. Many tests already exist for personality, intelligence, stress, innovation and coping (Austin et al (1998)), and these can be used for observing the basic psychological characteristics of farmers, though, as they have been developed and tested for the general population, some modification to better suit primary production situations may be appropriate.

Tests, according to Kline (1993), must be reliable, consistent and valid. It is also necessary to have test values for normal populations so individual test recipients can be assessed relative to these norms. Reliability refers to stability over time and internal consistency - you get the same results with test and re-test situations given reasonable time lapses.

Kline (1993) defines a valid test as one that measures what it purports to measure. Thus, if a test is for fluid intelligence then clearly it needs to be tested to ensure it does this. Validity assessment requires other measures to relate to. Thus, school results might be correlated with the intelligence test results. An overall test for managerial ability for farmers that profess to be profit maximisers might be related to historic farm profit data suitably amended for time trends.

Having developed a test it must be standardised (Kline, (1993), p 42) - that is, population samples are used to develop expected scores. Normal sampling and stratification procedure should be used. Use of regression analysis over large samples enables creating correction factors for age, education, sex and perhaps other potentially modifying parameters that should be eliminated (e.g., farming type experience).

All proposed test questions need to be analysed for correlation and the underlying factors. Kline (1993) believes factor analysis (Lewis - Beck (1994)) should be used to ensure each test group only tests for one basic factor, otherwise the results can be confounded without being clear what exactly the test is measuring. Thus, test development requires initially setting up a series of questions designed to test, in this case, a competency, then using the set on several samples, testing its reliability and validity, and then developing norms after proper factor and statistical analysis. Matthews and Deary (1998) also discuss these procedures with a particular emphasis on using factor analysis to ensure isolating the underlying structures.

It will also be necessary to develop a range of competency enhancement training programmes.

These can range from group programmes to courses for individual tuition with or without tutor support for each competency. Use of computer based programmes must also be considered including simulation games. Salmon (1980) believes games are a powerful way to alter beliefs. Initially dichotomous approaches should be used to indicate the most rewarding approach for each competency. Learning principles (Nuthall, 1997) should be allowed for in the designs.

It will be necessary to quantify the relationships between tests and outcomes if for no other reason to assess the potential gains relative to costs. However, it will also be important to obtain a basic understanding of the personality and intelligence relationships to the various competencies and their change.

10. CONCLUSION

Efficient production and appropriate goal attainment depends on the correct resource allocation. Research into the technology of production has dominated the study of efficiency, though economists have also played a part, though relatively insignificant in research dollar terms, through developing and applying production economic, decision and related models. Farmers, however, have seldom used such models (Malcolm, (1990)), and Ohlmer (1998) relying largely on common sense to make their decisions. Their success levels vary enormously.

It has been argued that for this research to proceed it is necessary to introduce what psychologists have learnt about cognitive processes, judgement and decision making into a new programme. This should ascertain the important competencies and develop valid and reliable tests for these competencies, create competency training programmes, and then test their effectiveness. Due to the complexities of the human mind, and the many components to manage, it will take many years of research to enable assessing the likely payoff for well tested training regimes that are designed for both group and individual use. Due to the unique nature of primary production and its complexities, while lessons can be obtained from work on ~~management in business~~, it is suspected specific procedures and programmes will be necessary.

In 1990, Stevenson et al (1990) noted (p 364) Judgement and decision making research has made few inroads into our psychological understanding of cognition and choice. We think this will change. The opportunities for applying this to primary production are clearly significant and potentially profound.

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