Sources of Motivation in the Adoption of Conservation Tillage

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Executive Summary

To date, research on agriculture and conservation has been largely devoted to attempts to identify farmers who are most likely to 'adopt' a particular conservation practice or technology. Based on the Adoption-Diffusion model, this research has identified farmers in terms of socio-economic factors such as age and education or farm characteristics such as farm size or farm type. This research has been criticized on several points two of which are: it's inability to address the fact that conservation practices in agriculture are complex and variable, and it's inability to reflect the complexity of the individual's decision-making process.

This study presents a methodology which partly answers the above concerns by facilitating the 'mapping' of ideas or sources of motivation. This process is applied to a survey in which farmers were asked to rate the importance of a variety of motivational and behaviourial factors.

The result of this process is the grouping of respondents into four distinct 'clusters' which appear to be largely differentiated by the degree to which farm survival at a personal level is a motivating factor. Those farmers who appear to be most strongly motivated by survival tend to be the youngest, least educated and least experienced, farming the largest acreage. These farmers show average to good cropping, rotation and tillage practices though they use the least number of water management practices. Those farmers who appear to be least strongly motivated by survival have the highest average education, and farm the smallest acreage, they show average to good rotation, cropping and tillage practices and use the greatest number of water management practices.

1 Introduction and Problem Statement

Concerns over soil loss, and water quality impairment due to agricultural activities have prompted an assessment of the relationship between agriculture and conservation. Much of the current research in this area is based on preceding research into the adoption and diffusion of ideas and technology in agriculture. There is some disagreement as to how appropriate this model and its approach are to research into questions of agriculture and conservation.

This is an exploratory study, intended to examine the potential application of a set of analytical tools which have to date not been applied to the questions of agriculture and conservation. Specifically, a phenomenological model of experience and perception -- personal construct theory (Kelly, 1955) -- will be used in place of the traditional behaviourist model. This change in model will necessitate the use of appropriate analytical tools: multi-dimensional scaling, and cluster analysis. Due to the lack of similar research this study will not seek to develop and test formal hypotheses, rather this study will explore the application of the research tools identified above, describe the results of this application (largely in a qualitative manner), and relate these results to the results of previous studies.

2 Literature review summary

A good deal of research in rural sociology has addressed itself to the adoption and diffusion of new agricultural technologies and a substantial bodyof literature and theory has resulted from this.

With the emergence of renewed concern over soil erosion, and with the use of 'conservation tillage' technology being seen as a major solution, we may expect that rural sociology would provide insights regarding the mechanisms and process of technological change, which in fact it has. However within rural sociology some doubts are being raised as to the utility of the 'Adoption-diffusion model' and it's attendant theoretical structure.

The literature pertaining to changes in tillage technology provides us with a good example of this current debate and its application in helping todetermine policy directed toward reducing soil erosion.

Attention has already been paid to the problem of conservation and agriculture, primarily in the fields of rural sociology and agricultural economics. To date however, little has emerged by way of a clear theory or model of the relationship between conservation and agriculture. In fact, the conclusions of many studies appear to conflict.

Studies of social and technological change in rural sociology and extension have long been dominated by the adoption-diffusion (A-D) model (Rogers 1983; van Es 1983). This model is based on the assumption of a the individual as being highly rational and limited in choices by available information, and disposition toward risk-taking. It has been argued by anumber of researchers thatthis modelis ill-suited to the study of agriculture and conservation (Nowak 1983; van Es 1983; Buttel 1980). And attempts have been made to alternately repair or replace the A-D model. To date, this process of model formulation has been without commonly recognized success, and evidence suggests that implicit assumption made by researchers regarding the beliefs and motivations of farmers represent one source of the ongoing difficulties.

Much of the literature to date has sought to link characteristics of farm and farmer to particular behaviour, such as the use of a conservation technology. Less often considered is the motivation behind this behaviour.

It has been pointed out that conservation technologies such as low-tillor no-till systems are seldom discrete: that is, the adoption of such technologies influences many aspects of the farm operation. Modelling of such a complex behaviourial situation without an underlying model of motivation forsuch actions invites discrepancies.

At a broader scale, the topic of agriculture and conservation has been addressed by both the empirical and critical schools of rural sociology with some shortcomings (Buttel 1980; Rogers 1981; Lowe & Warboys 1980). The empirical approach, typically based upon studies of technological A-D. has been criticized for failing to recognize the broader social and philosophical aspects of the phenomenon under study. So, too, much of the critically based research can be criticized for failing to produce comprehensive theory or empirical justification.

This chapter will present a review of the current literature on agriculture and conservation. The first section of the review the A-D model and research based on it, the second will review alterations to the A-D model and associated research, and the third will present a variety of alternative approaches which may address some of the more glaring shortcomings of traditional research.

2.1 The adoption-diffusion model

Adoption-diffusion research is based upon a model that states simply that "an innovation is communicated through certain channels over time among members of a social system" (Rogers 1983). A-D research, then, is concerned with tracing the lines of communication by which innovations are transmitted in a social structure, the process by which changes take place, and the socio-economic profiles of the groups under consideration. The basic element of the A-D model is the individual process of decision making with regard to the innovation in question. Rogers (1983) describes a five-stage model of the individual "innovation-decision process." These stages are (1) **knowledge,** (2) **persuasion,** (3) **decision** to adopt or reject, (4) **Implementation** of the decision, and (5) **confirmation.**

Research into the adoption of innovations appears to have emerged in several unrelated disciplines almost simultaneously during the 1940s and 1950s, drawing from the emerging tradition of qualitative empiricism, functionalism, and positivism in the social sciences, particularly behaviourial psychology (Rogers 1981). It was not until the late 1960s that A-D emerged as an interdisciplinary model of social change (Rogers 1983).

It is worth noting here that rural sociology and extension studies have accounted for more literature based on the A-D model than any other study area. As of the early 1980s, 26 percent of all diffusion literature emanated from rural sociology; three decades earlier this proportion was much higher (Rogers 1983). The strengths of the A-D model lie in several areas. Adoption-diffusion research provides a highly pragmatic methodology, and facilitates the creation of conceptually simple models that often have a high degree of validity or significance. In describing a study of the adoption of conservation technology, Korsching et al. (1983)

concluded that the A-D model "has a high degree of reliability in explaining the process and predicting the outcome of the introduction of a new technology to a target population."

Having a pragmatic and less complex model renders field study and hypothesis testing easier. This factor, combined with the large volume of existing A-D research, means that researchers using this model are better able to develop "neat" research agendas that prove relatively easy to study in the field. The high degree of reliability or statistical significance that one may derive from A-D based studies makes the results of such studies attractiveas a tool for policy formulation.

Increasingly, however, over the past decade, criticism has been levelled at A-D based research.

With the emergence of a "critical" rural sociology came a questioning of the relevance or applicability of empirical or purely quantitative research. Concurrent with and not unrelated to this shift appeared a change in the focus of research issues to more complex and dynamic questions that often stretched or defied the utility of empirical methodologies (Newby & Buttel 1980). Some writers have argued that the facility of A-D research has had an inordinate influence in determining research agendas -- the "tail wagging the dog" (Nolan& Galliher 1973).

Rogers (1983) has synthesized much of the criticism of A-D research into four categories:

1. A-D research appears to be pro-innovation -- that is, observable events are the adoption or diffusion, not the non-adoption or non-diffusion, of innovations.
2. A-D research tends to emphasize the role and responsibility of the individual as decision maker to the exclusion of consideration of the larger social, economic, and political environments that the individual inhabits. Rogers stops short of suggesting that this may be indicative of an ideological agenda, but other writers such as Buttel and Newby (1980) and van Es (1983) do argue for this possibility.
3. A-D research does not appear to handle well the dimension of time. Rogers (1983) attributed this largely to problems with the objectivity and accuracy of recall and memory among respondents.
4. Likewise, the A-D model does not allow for analysis of causality.

With the exception of the last criticism, Rogers suggests that each of the shortcomings of A-D research, while valid, refers more to research than to the inherent character of the model itself. He suggests that each of these conditions may be avoided through adaptation and alteration of the research process. A number of researchers appear to agree with this position, and have utilized and modified the A-D model in the study of agriculture and conservation with varying degrees of success.

2.2 Altering the A-D model

The work of researchers like Nowak represents something of a middle ground between the "classical" rural sociology, which relies strongly on a structural functionalist approach and the A-D model, and the emerging "critical" rural sociology. In his 1983 paper, "Adoption and diffusion of soil and water conservation practices," Nowak addresses several major criticisms of the classical model and proposes a model which is still based on the choices made by the individual operator, yet more specifically identifies external factors that influence these choices.

Nowak suggests that in so far as the classical A-D model considers "an innovation [that] is communicated through certain channels over time among members of a social system" (Rogers 1983), it is valid and useful. He goes on to identify several area in which his model differs from the classical model as it is typically applied. Nowak de-emphasizes the importance of the social and psychological characteristics of the individual and emphasizes the influence of outside factors such as educational infrastructure, policy environment, market, and regulations.

In addition, Nowak notes that the adoption of a particular technology is complicated by the complex and diverse nature of most conservation technologies. Conservation technologies tend to be complexes of technology and technique, rather than discrete inventions. Nowak also assumes that such conservation technologies tend not to be simply adopted or not adopted -- rather, they tend to evolve and mutate to meet local conditions. As a result, two stages -- "utilization" and "adaption" -- replace "adoption" as the end product of the process.

While Nowak provides us with a model of the adoption and diffusion of conservation technologies that appears to answer many of the criticisms addressed to the "classical" model, he leaves some complaints unanswered. In the process of introducing his model, Nowak raises the issue of voluntarism and its political expediency. However, he fails to address this directly in his model. In addition, by making conservation technology a more complex variable, Nowak makes it more difficult to measure, yet offers no help in measuring methodologies.

Korsching et al. (1983) state that:

> preventative innovations generally feature the following characteristics that can have a negative effect on the adoptionrate: high initial cost, low economic profitability, high perceived risk, low immediacy of rewards, and additional time and difficulty for implementation. Thus, they are not necessarily different from other innovations as innovations, but they are different to the extent that they are more difficult to accept by a population.

Nowak's work is widely referenced in this area, yet his model does not appear to have been reproduced in any empirical studies. One study (Napier, Camboni & Thraen 1986) has successfully tested a similar "path" model.

All the studies reviewed sought in some way or other to relate the adoption of conservation technology or a similar dependent variable to characteristics of the farmer or. the farm operation. These attributes may be considered under three broad categories: personal attributes, farm operation attributes, and community or communication attributes.

2.3 Personal and farm operation attributes

Personal characteristics of the individual respondent were the most commonly measured independent variables in the literature reviewed. The most significant individual attributes were age, education, and risk orientation. Motivation and orientation toward farming were less often studied, and were considered either as discrete dependent variables, or as part of a complex of dependent variables, including the adoption of conservation technologies.

Age of the operator or time involved in farming was measured in all the studies reviewed, with a range of results. Bultena and Hoiberg (1983) found a strong positive correlation between age and use of chisel the plow. Buttel et al. (1981) found that age did not correlate well with environmental concern. Korsching et al. (1983) found age to have a significant negative correlation with adoption of minimum tillage: younger farmers were more likely to be adopters of conservation tillage.

This confusing picture may be clarified somewhat by considering age in terms of causality. For example, Heffernan and Green (1986) found that:

> when the other independent variables are controlled, age, education, and worth/debt are not significant predictors of actual soil loss [the potential soil loss component of the Universal Soil Loss Equation plus cropping and tillage method],

but age had a significant negative correlation with potential soil loss (as determined by USLE and soils maps). They concluded simply that older farmers had land that was less prone to erosion. Likewise, using an interactive path model that tended to control for other related variables, Napier, Camboni and Thraen (1986) found that, by itself, age had no correlation with level of environmental concern.

Level of formal education as an independent variable is strongly linked with age and was also commonly measured. Bultena and Hoiberg (1983) found that education was only weakly correlated with use of conservation tillage, and Buttel et al. (1981) found that level of formal education did not correlate well with environmental concern. Earle, Rose and Brownlea (1979),however, concluded that education was significant as part of a linear discriminant function that predicted "conservation intention" among Australian farmers.

Ervin and Ervin (1982) found that level of formal education was significantly correlated with perception of the degree to which soil erosion was a problem, and with the number of conservation practices used by the farmer.

Heffernan and Green (1986) found that education did not correlate well with actual soil loss (USLE plus cropping and tillage) but was positively correlated with potential soil loss (USLE and soils maps). Not surprisingly, they also found that age was negatively correlated to level of education.

Pampel and van Es (1977) found that level of formal education predicted the use of economically positive practices but not conservation practices. Rickson and Stabler (1985) found education to be positively correlated with local environmental concern, and with technical knowledge related to local environmental issues.

Epplin and Tice (1986) observed that education represents a greater investment per unit produced on farms with lower output than on farms with larger output.

The orientation of the individual toward risk is theoretically considered to be highly predictive of the likelihood of adopting an innovation (Rogers 1983). Because early adopters are considered to be facing the highest risks, a positive or willing attitude to assuming risk is considered to be predictive of early adoption of an innovation. Generally, the most affluent farmers are considered to be the most well disposed toward risk taking. Nowak and Wagener (1982) found, however, that at the earliest stages of adoption, the less economically successful farmers are more likely to adopt new technologies.

In contrast, Bultena and Hoiberg (1983) found that orientation toward risk was only weakly significant in predicting the adoption of conservation tillage. Ervin and Ervin (1982) found that orientation toward risk was correlated with the number of conservation practices an operator used, but not with perception of the degree to which erosion was a problem. Miranowski (1982) found that risk orientation was not significant in predicting the choice of tillage practice.

Pampel and van Es (1977) found that the theoretical indicators of innovativeness or positive disposition toward risk -- such as capital, farm size, sales, and education -- predicted the use of economically positive technologies, but did not predict the use of technologies that are environmentally positive, but economically neutral or negative. Smathers (1982) echoes these findings and concludes that, while reductions in erosion are attainable, a combination of high risk and economic adversity make targets of zero erosion unattainable.

Napier, Camboni and Thraen (1986) found that farmers who were more concerned about risks tended to be more concerned about environmental issues during the process of adopting new technologies.

Characteristics of the farm operations in question were considered in many of the studies reviewed. In most cases these farm attributes were studied as independent variables used to predict conservation behaviour, or the adoption of conservation technology. These criteria included farm size, type of operation, and economic criteria such as capital and debt. Criteria such as the number of conservation practices in place, or the use of chisel plow or no-till, were most often used as dependent variables.

It has been hypothesized that larger farms are run on a more mechanized or industrial basis, and are operated by farmers who are more concerned about profit and production, and less ecologically concerned. Buttel et al. (1981) tested this hypothesis and found that farm size had a negative correlation with environmental concern. Bultena and Hoiberg (1983) found partial support for a hypothesized correlation between farm size and the use of the chisel plow. Pampel and van Es (1977) found farm size to be predictive of the use of economically profitable farm practices, but not of ecologically profitable practice.

Alternatively, it has been hypothesized that larger farm operations are better able to change technologies and cropping practice, and are better able to make long-term investments. Epplin and Tice (1985), using micro-economic modelling, found that on smaller farms the cost of equipment becomes a much greater impediment to the adoption of conservation tillage than on large farms. Earle, Rose and Brownlea (1979) found farm size to be a significant part of a model that predicted "conservation intention" among farmers. Rahm and Huffman (1984) found that farm size had a positive role in a linear program which predicted the use of reduced tillage.

Type of farm operation has been suspected of having a correlation to use of conservation practice and technology. In particular, soil type and erosion potential, where considered, have been seen as strongly related to conservation practice.

Epplin and Tice (1985) found -- not surprisingly -- that farm type or system affected the cost of adoption for conservation tillage. In their study, adoption of no-till systems for corn in the American corn belt was less costly than the adoption of no-till for wheat on the Great Plains.

Ervin and Ervin (1982) concluded that only education and soil erosion potential were significantly related to perception of an erosion problem. Soil erosion potential was also found to be correlated with effort. Heffernan and Green (1986) concluded that erosion potential is the strongest predictor of estimated soil erosion, whereas gross farm sales had a relatively weakcorrelation to estimated soil loss.

2.4 Alternatives to the A-D model

In his 1983 paper, "The adoption /diffusion tradition applied to resource conservation: Inappropriate use of existing knowledge," J.C. van Es brings the emerging critique of "classical" ruralsociologyto the issue of agriculture and conservation. In doing so, van Es and those authors who agree with his model represent the influence of the new critical rural sociology in the ruralsociology literature reviewed for this paper.

For the most part, van Es focuses upon the inadequacies of the A-D model, and only points in the directions that researchers might take in thedevelopment of alternatives.

Van Es suggests that the linkage between the A-D model and conservation policy lies in the nature of environmental impacts as the product of technological change. Policies that respond to these situations and are basedupon the results of A-D research are predicated on the free will of the individual operator: that is, the individual's choice to adopt a technologythat will have a negative impact. This is the basis of the structural functionalist paradigm in rural sociology.

As a result of conservation policy based on the A-D model, problematic situations arise: for instance, we cannot assume that individual choices that benefit the "common good" are essentially the same as those that benefit theindividual operator. Because the A-D model grew out of the study of economically positive technologies, it is based uponindividual choice to optimize along such lines.

Van Es offers at least preliminary evidence suggesting that motivation to optimize for conservation and long-term benefits is not the same as motivation to optimize for short-term economic benefit (Wilkening & Klessig 1976; van Es & Pampel 1976). In addition, it would appear that these different types of motivation are not homogeneous.

A number of researchers have concluded that those farmers who are most responsive and motivated to resource conservation and public welfare considerations are not necessarily those most responsive to innovations that enhance productivity (Kronus & van Es 1976; Pampel & van Es 1977; Hoiberg & Bultena 1981).

This situation carries with it several significant ramifications; for example, Napier, Camboni & Thraen (1986) suggested:

> that the use of traditional information transfer methods [access to institutional and noninstitutional sources of information] will have little influence on the relative importance placed on environmental concerns in decision-making.

Van Es goes on to point out that little research appears to have been done on the effects of government programs that require mandatory participation, in spite of the fact that many such programs exist. Van Es concludes that the A-D model, with its well-developed conceptualization and methodology, offers researchers a powerful tool, but one that diverts attention away from important issues. Furthermore, the ideological premise upon which the A-D model is based tends to favor political expediency over the development of effective policy.

To date, little by way of published research based on the perspective put forward by van Es has appeared. Nor has work based in the 'critical' rural sociology been able to address empirical research into agriculture and conservation. The remainder of this chapter is devoted to theoretical perspectives which form the bases of an alternative to the A-D model which is also appropriate to empirical research.

2.5 Need theory

The work of Abraham Maslow forms the basis of many examinations of motivation. Maslow's (1943) "need theory" postulates that the individual is motivated to act upon five basic needs:

1. *physiological needs* -- the need for food and shelter;
2. *safety needs* -- the need for assurance that food and shelter will continue to be available;

3. *belonging needs* -- the need for love, affection, and the company of other individuals;
4. *esteem needs* -- the need for respect and positive self-image; and
5. *self-actualization needs* -- the need of the individual to reach his or her fullest potential.

These headings represent groups or types of need; the specific aspects of these may vary greatly between individuals. Need theory states that the five basic needs represent an approximate hierarchy, from basic and immediate needs to more abstract, "higher-order" needs. In most cases, an individual will be motivated to address the most immediate perceived need. For example, Maslow suggests that a individual will not perceive or act upon a need for esteem until safety needs have been met.

The implication of need theory for motivation is that in order to be most efficient, the information associated with an initiative should match the perceived needs of the intended receiver. For example, encouraging the adoption of a behaviour for altruistic reasons -- contributing to "the common good" -- will not likely be effective if the intended receiver is concerned about short-term economic survival.

This presents an elegant and logical model of priority setting and motivation. It is, however, subject to a high degree of variation between individuals. Perceived need, or level of need, will vary greatly between individuals. It is important to remember that needs are not strictly hierarchical, or mutually exclusive. Individuals act upon a range of needs at any given time. The premise of the theory remains, however, that individuals will tend to be most concerned with the lowest-order need that is for the most part unsatisfied.

In recognizing need theory, policy makers should consider the characteristics of programs and initiatives in terms of their relationships with need types.

2.6 Intrinsic and extrinsic motivation

When discussing motivation, particularly with regard to policy objectives, it is important to make the distinction between intrinsic and extrinsic motivation. Extrinsic motivation refers to motivation that is external to the innovation or behaviour in question. For example, a subsidy represents extrinsic motivation. Intrinsic motivation refers to aspects, characteristics, or attributes of the innovation or behaviour itself that form a source of motivation -- such as lifestyle or personal satisfaction. Recent evidence suggests that intrinsic motivation may form the basis of more successful and long-lived change with regard to environmental behaviour (DeYoung & Robinson 1984).

Intrinsic motivation results in behaviour that tends to be self-reinforcing, whereas extrinsic motivation leads to behaviour that will not sustain or reinforce itself. From the perspective of the policy maker, intrinsically motivated behaviour is most desirable, since it will not require ongoing external support. In order to be effective, the promotion of an innovation through subsidy (extrinsic motivation) will -- among other things - - require either an ongoing commitment to that subsidy or the potential for the discovery by the adopter of sources of motivation intrinsic to the behaviour.

2.7 Community: Belonging and esteem

The importance of rural community in transmitting information and reinforcing norms has been demonstrated time and time again. The community and its structure will influence the nature and rate of information transmission, and the community will determine the acceptable range of deviation from its norms. According to need theory, the needs for belonging to community and for esteem or recognition occupy the middle of the needs hierarchy, following needs for short- and long-term physical security, and preceding the need for self-actualization. When acting upon these needs, we may expect the individual to be motivated to accept and conform to community norms and beliefs in order to "belong." Following this, the individual may be motivated to achieve recognition or community esteem.

The adoption of conservation tillage has been shown to be strongly related to perceptions of "others' responses to conservation tillage" (Bultena & Hoiberg 1983).

Conversely, it has also been suggested that communityopinion will reinforce local norms:

> Once committed to using an innovative tillage system, farmers may develop a distorted picture of the local popularity of that system-- perceiving more support than actually exists. (Bultena & Hoiberg 1983)

Rogers (1983) has described the role of "opinion leaders" in leading or influencing community behaviour. By definition, these individuals are part ofthe community, and usually hold some elevated or central status.

2.8 The Theory of Personal Constructs

Personal construct theory (PCT) was postulated by Kelly in 1955 as a theory of cognition and perception. It is rare among psychological theories in that it was put forth as a complete, formal statement, this factor among others makesit useful in applications outside the realm of psychology.

The fundamental postulate of PCT is that "A person's processes are psychologically channelized by the ways in which she/he anticipates events".

Personal construct theory has been used successfully in the study of environmental cognition, and the evaluation of landscapes (Downs 1976, Pomeroy et al 1983). In landscape assessment, PCT has provided a theoretical and methodological solution to the problem created when rational economic man isused to explain issues of perception and aesthetics.

Personal construct theory states that the individual's relationship with the world is based upon a set of events which hold some relationship with each other, forming a 'construct'. In most individuals, this construct is not fixed or absolute, but rather is under constant revision as the individual anticipates future events and relates the expected outcome of the events withthe actual or perceived results.

In this way PCT states that each individual has a different set of constructs based upon the individual's experience, and that individual's perception of and action in the world will differ accordingly. (Kelly 1955, Jackson 1986).

2.9 Conclusions and problem statement

The first sections of this chapter outlined the state of existing research into agriculture and conservation, and the state of the modelling upon which it is based. Several conditions are apparent. It appears that research in this area is presently unable to reflect ethical or moral concerns, it is oriented to action or behaviour, rather than underlying perceptions and beliefs, it utilizes a model of perception and experience which is outmoded, and unable to adequately address contradiction and anything less than perfect rationality.

The second half of this chapter has outlined some ideas which can form the basis of an approach to agriculture and conservation that is more 'humane' and perhaps more informative, though perhaps less conclusive. The following chapter will outline the methodology of a test of this approach.

3 Methodology

The study was carried out by means of a short mail-out questionnaire regardingmotivation which was administered to a group of individuals who had participated in an earlier extensive survey of cropping and conservationpractice.

3.1 Sample

In 1983-84 the Ontario Institute of Pedology conducted a detailed survey of the cropping and conservation practices of 1029 farmers in Southwestern Ontario. A random selection of four hundred was made from respondents to that survey for inclusion in the current survey. Of these 25 were incorrectly addressed so a total of 375 questionnaires were mailed out. Questionnaires were posted in late June 1987. Thirteen questionnaires were returned due to incorrect addresses, or the recipients having left farming. With no follow up, a total of 107 completed questionnaires were returned for a response rateof 28 percent.

3.2 Questionnaire

In earlier personal interviews with farmers and farm related individuals economic concerns were almost always cited as the most important, if not the only, source of motivation in farming. Accepting this, the questionnaire and subsequent analysis were designed to de-emphasize economics, and seek to describe the relationships between economics and other concerns with the more broadly defined sources of motivation identified by Maslow (1956).

The questionnaire consisted of three sections. In the first section farmers were given definitions for the following five terms: survival, sustainability, community, leadership, and stewardship. Space was provided for altering or correcting the definitions if they wished. Farmers were then asked to rate the importance of each of these concepts as sources of motivation to themselves, and to estimate the role of these concepts as sources of motivation to neighbours, and farmers in general. In the second section farmers were given a list of 19 practices behaviours and ideas, and asked to rank the importance of these. Finally, farmers were asked to supply some basic socio-economic information which was not present in the OIP survey.

In instances where respondents provided the same rating for each of the five terms to themselves, neighbours or farmers in general, these responses were counted as missing. Behaviourial data were drawn from the results of the OIP survey. A series of indices were developed to simplify the raw data.

Crop rotations were scored according to conservation value; rotations using only row crops were accorded a value of 1, rotations of row crops and cereals were accorded 2, row crops, cereals and forage 3, row crops and forage 4 and cereal and forage 5 (Driver and Wall, 1984) (Wall pers. comm. 1987). For the purposes of this survey, where two or three rotations were present, an aggregate score was calculated.

A cropping practice index was calculated based on the use of the following practices: winter cover crops, strip cropping, cross slope cropping, and use of clover plowdown.

A tillage practice index was calculated in the following manner: a score of 1 was accorded to operators using a mouldboard plow in the fall, a score of 2 for use of the same in the spring only, a score of three was given for use of something other than a mouldboard plow for primary tillage in the fall, and a score of 4 for the same in the spring only. For secondary tillage, fall discing added 1 point, spring discing only added 2, and spring secondary tillage using other than a disk only added 3.

An estimation of the average number of tillage passes made was calculated as a second tillage index.

A surface drainage index was calculated based on the number of the following practice used: grassed waterways, drop structures, tile outlet protection, gully control, and controlled access of livestock to streams.

Finally, an index of observed problems was calculated based on the observation of the following: water erosion, wind erosion, ditch bank erosion, soil compaction, and poor soil structure.

3.3 Analysis

Simple correlations of socio-economic variables and tillage and conservation behaviour were performed on the raw data set. These data were then compared with the results of preceding studies.

The following process was performed in an attempt to group respondents according to apparent differences in perception or motivation. Groups within the data set were identified, aggregate maps of perceptions and motivations were developed. Simple correlations of socio-economic variables and tillage and conservation practice were then performed and the results were compared with those for the full data set.

Grouping of respondents was achieved by using multi-dimensional scaling (MDS Joint Euclidean Model) to reduce the 34 question by 107 individual data set to a minimum number of dimensional weights for each individual. Cluster analysis was then performed on the dimensional weights in order to establish the optimal number of groups and the group identification of each individual.

In order to create an aggregate mapping (supergrid) of the personal constructs identified by farmers in the questionnaire, simple correlations were run on each question (or stimulus) of the data set for each cluster. The resulting set of 34 by 34 cell matrices then represents a table of the similarities -- or the inverse distances -- between each question or the idea which the

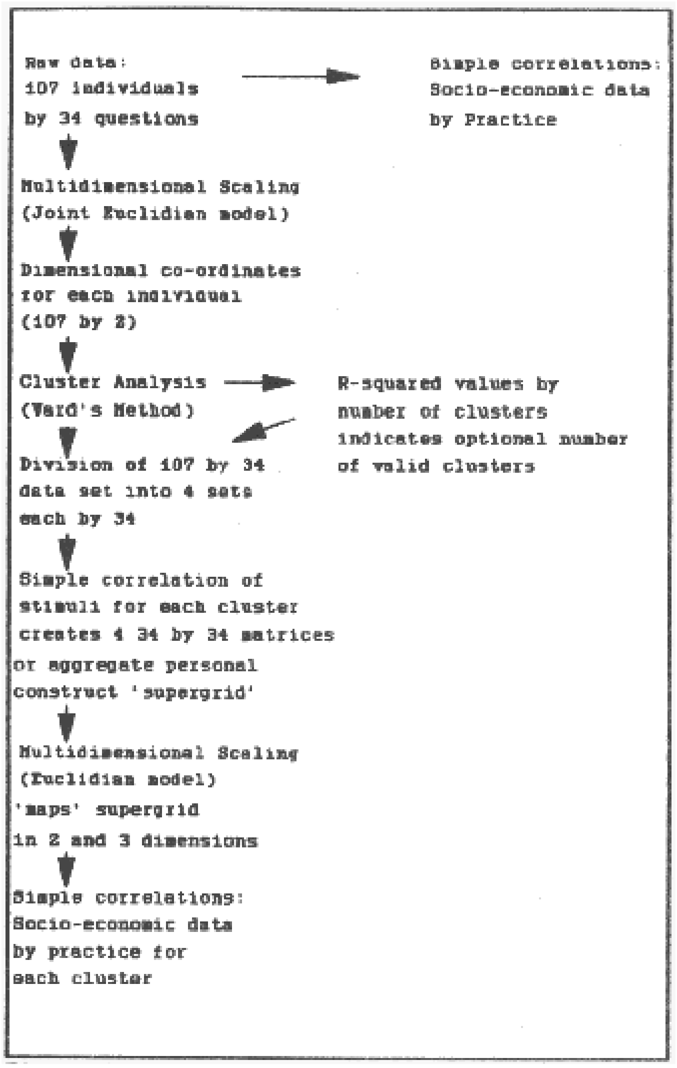

Figure 1. Outline of Analytic Process

question represents for each cluster. Classical multi-dimensional scaling (MDS Euclidean Model) was then performed on these matrices in order to reduce each of them to a set of weights in the minimum necessary number of dimensions. Each of the constructs appear below in two and three dimensions.

Finally, simple correlations of socio-economic variables and tillage and conservation behaviour were then performed in order to determine the relationshipbetweenperceptionorconstruct and socio-economicstatus or behaviour.

3.4 Analytical Techniques

This section presents discussion of several analytical techniques used in this study. This includes multi-dimensional scaling (MDS) and cluster analysis. In addition, somegeneral discussion of validity will be provided.

Multi-dimensional scaling (MDS) is a computational method whichcan reduce a matrix of similarity or difference data to a table of dimensional coordinates. Data may then be examined as a 'map' which may make evident structures or relationships within the data.It is possible using MDS, to compute results in n dimensions, however the lack of good techniques for presenting results in space with greater than 3 dimensions limits the utility of, say 6-dimensional solutions. In many cases increased dimensionality yields increasingly accurate solutions presenting results in space with greater than 3 dimensions limits the utility of, say 6-dimensional solutions. In many cases increased dimensionalityyields increasingly accurate solutions.

In this study, matrices of proximity were obtained by computing simple correlations between subjects (individuals) in the case of the originalclustering, and objects (questions) in subsequent analyses.

MDS has been used extensively in the fields of psychology and sociology in measures of perception (Kruskal and Wish 1978) as well as in biology for studies of taxonomy. Recently MDS has been used successfully in identifying variables which underlie landscape preference (Pearce and Waters 1983)(Pomeroy 1982). To date, MDS does not appear to have been applied to the topic of agriculture and conservation.

MDS is actually a set of algorithms and computational procedures. Scaling in this study was accomplished using the euclidean model as applied bythe ALSCAL procedure available through SAS version 5.

In addition to dimensional data, ALSCAL provides R^2 indices for each set of results. R^2 is the squared correlation index and may be interpreted as representing the degree to which variance of disparities is accounted for by the MDS model. It is the recommended measure of internal consistency. (Young& Lewyckyj 1979). Generally R^2 values of over .90 are considered to be acceptable, although values of .80 and perhaps lower may be used with great caution (Pearce & Waters 1983, Kruskal & Wish 1978).

Cluster analysis has been used in this study to form groups based on dimensional coordinates supplied by analysis using MDS. As with MDS, cluster analysis refers to a variety of procedures which are used to classify and group. In this study, Ward's method is used. (see Aldenderfer & Blashfield 1984). This is a clustering method which is designed to optimize minimum variance within clusters. The choice of Ward's method was based largely on it's wide acceptance in the social sciences. Ward's method has been shown to outperform most other clustering methods under conditions where clustersoverlap, which they appear to do in this study.

4 Analysis

4.1 Full data set

As a preliminary test of the assumption and results of preceding research, simple correlations were performed for the full data set on socio-economic and behaviourial variables. Age, education, farm size and farming experience were the socio-economic variables most commonly cited as being correlated with conservation practice (see chapter 2), and rotations, cropping, tillage practice, water management, and reported conservation problems were analyzed as behaviourial variables. The results of this analysis (Table I) indicate that no significant simple correlations were apparent between socio-economic and behaviourial variables. Raw mean scores for the full data set, and forthe subsequent clusters appear on .

Table I. Frequencies for Socio-Economic and Behaviourial Variables

Variable	N	Mean	Std Dev
ROTATION	93	2.612903	0.872680
CROPPING	107	2.074766	0.918376
TILLAGE1	107	2.523364	0.649322
TILLAGE2	105	2.914286	1.038807
WATER	107	2.130841	1.428049
OBSERVED	94	2.319149	1.147346
SCORE	107	9.000000	2.231845
AGE	101	47.633663	13.227035
EDUCATION	100	3.120000	2.345337
EXPERIENCE	99	28.505051	15.645547
FARM SIZE	107	154.728972	49.645834

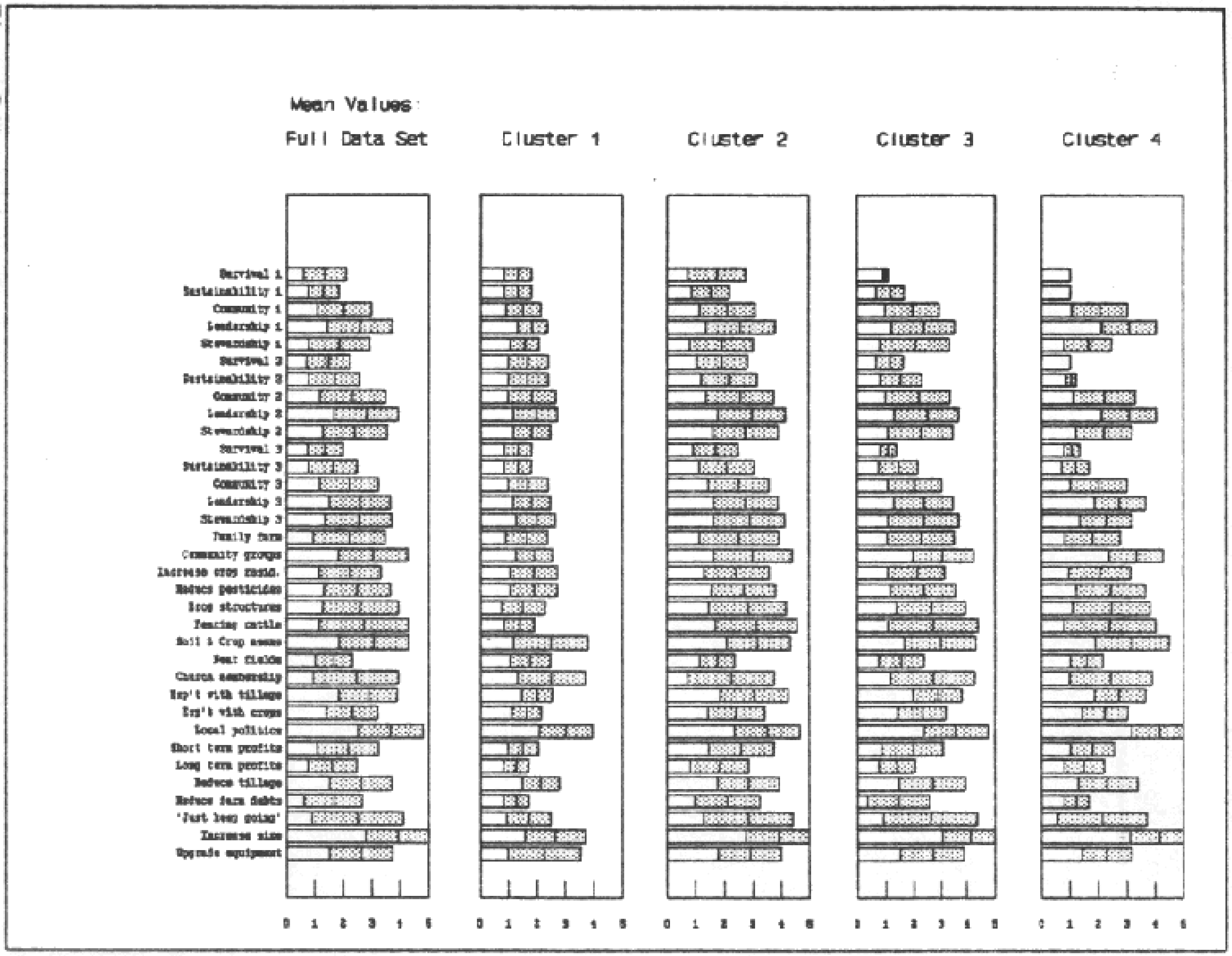

Figure 2 Mean values for full data set and clusters

Table II. Correlation of Socio-Economic and Behaviourial Variables

	ROTATION	PRACTICE CROPPING	TILLAGE1 # PASSES	TILLAGE2 PRACTICE	WATER	OBSERVED PROBLEMS	AVG. SCORE
AGE	0.129	0.118	0.049	-0.049	0.016	-0.078	0.102
	0.23	0.23	0.62	0.62	0.86	0.46	0.30
EDUCATION	0.067	0.039	-0.053	0.020	0.051	0.240	0.083
	0.53	0.69	0.5	0.83	0.61	0.02	0.40
EXPERIENCE	0.061	0.181	-0.003	-0.007	-0.046	-0.010	0.052
	0.57	0.07	0.97	0.94	0.64	0.92	0.60
FARM SIZE	-0.123	0.209	-0.126	0.109	0.091	0.112	0.096
	0.23	0.03	0.19	0.26	0.34	0.27	0.32

Correlation Coefficients / Prob > |R| under Ho: Rho = 0 / Number of Obs

4.2 Clustering the full data set

The full data set was then divided into clusters based on variations in scored questions (questions in which motivation or practices were evaluated according to their importance). It was assumed here that these answers in composite represent constructs of motivation and behaviour, and respondents would therefore be grouped according to similarity. As described in chapter 3 the first step in this process was to reduce the 34 answers supplied by each respondent to the minimum number of dimensions by means of multi-dimensional scaling (MDS). Using the joint euclidean model, individual's responses were reduced to 2 dimensions with an R^2 value of .999. In order to group the individuals, cluster analysis (Ward's Method) was

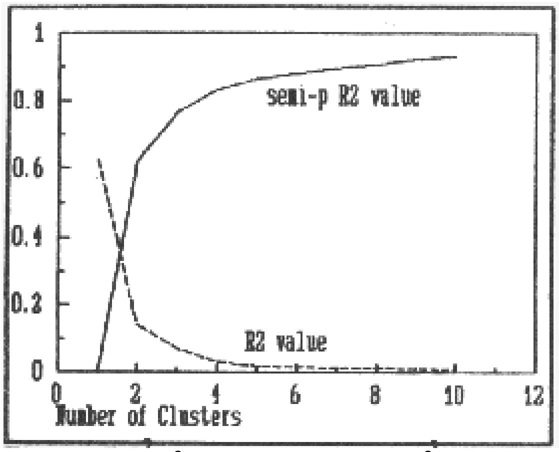

Figure 3. R^2 and semi-partial R^2 values plotted against number of clusters

then performed on the two dimensional coordinates of each individual. Figure 2 shows R^2 and semi-partial R^2 values as plotted against number of clusters. This figure indicates that between two and four valid clusters exist. With four clusters R^2 has a value of .83 while at two clusters, this value falls to .62. Two dimensional coordinates, and the resulting clustering appear on Figure 3 . The remainder of this study will concentrate on the results of the four-cluster solution.

Mean values for questionnaire responses for the full data set, and for resulting clusters appear on Figure 1.

Aggregate constructs or supergrids were constructed for each cluster. Initially, all 34 scored questions were used to form constructs for each of the four clusters. Under these conditions multi-dimensional scaling of clusters 1 and 2 in two dimensions yielded low R^2 values: .568 and .659 respectively, cluster 3 was marginal at .761, and cluster 4 was .939. In clusters 3 and 4, the 'importance of survival to you' variable is highly differentiated, and most of the other variables (particularly in cluster 3) tend to aggregate. This suggests that for clusters 3 and 4 the idea of survival is by far the most strongly defined idea in the aggregate constructs. It is worth noting that survival may then form a major axis through the initial clustering.

Leaving consideration of survival aside for a moment, there appears to be little else by way of strong definition in the aggregate constructs. The low R^2 values may be seen as representing low internal consistency in the constructs as scaled. Scaling of clusters 3 and 4 without the variables representing survival yielded R^2 values similar to clusters 1 and 2. For this reason, motivation and behaviourial variables were scaled separately. Unable to accurately relate motivation and behaviour, they were mapped separately. Two dimensional constructs of motivation appear on Figure 4, and constructs of behaviour appear on Figure 5. Following this, constructs were formed in three dimensions, yielding R^2 values of 0.9 or better. The following descriptions of results will refer to the three dimensional solutions.

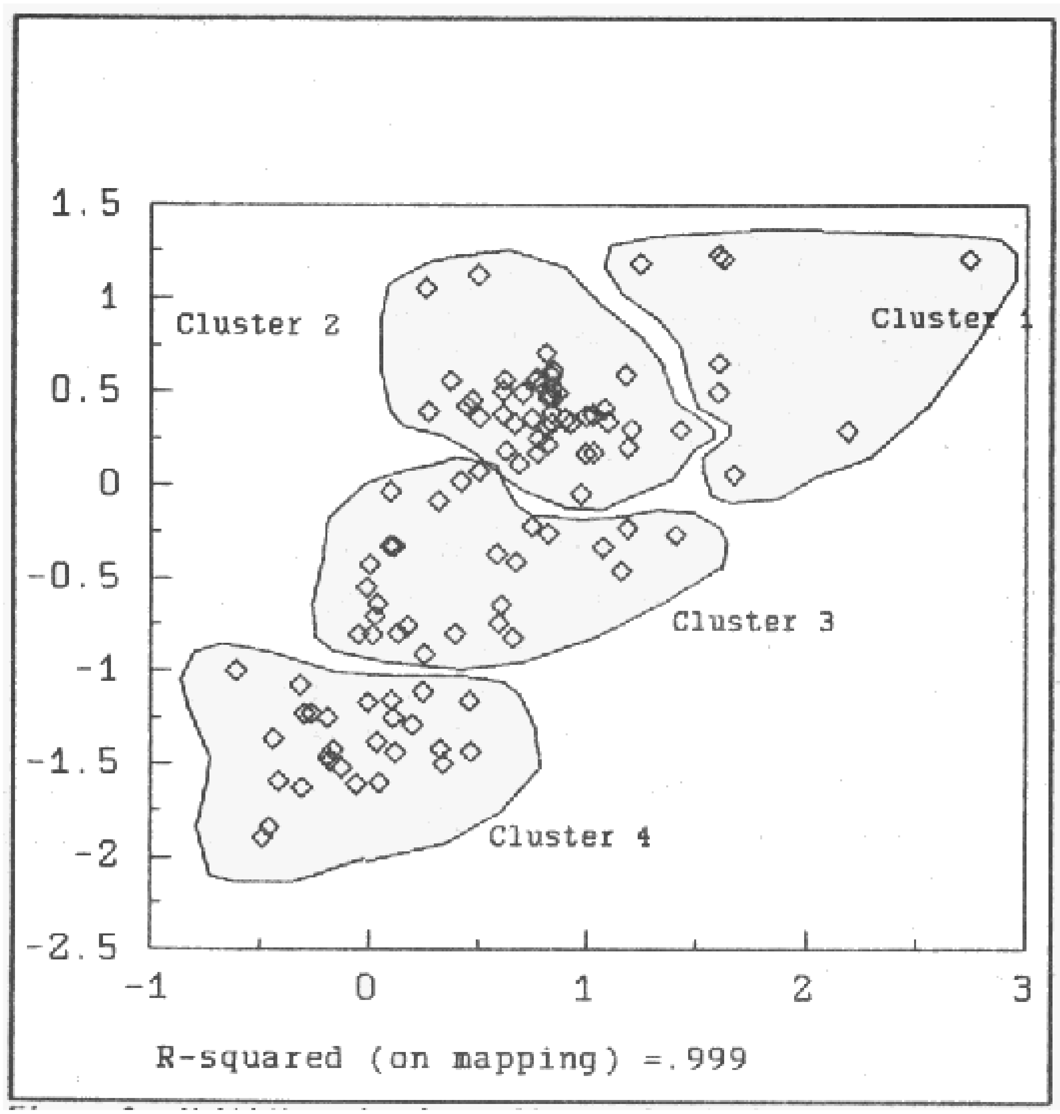

Figure 4. Multidimensional scaling of individual data and clustering of resulting coordinates

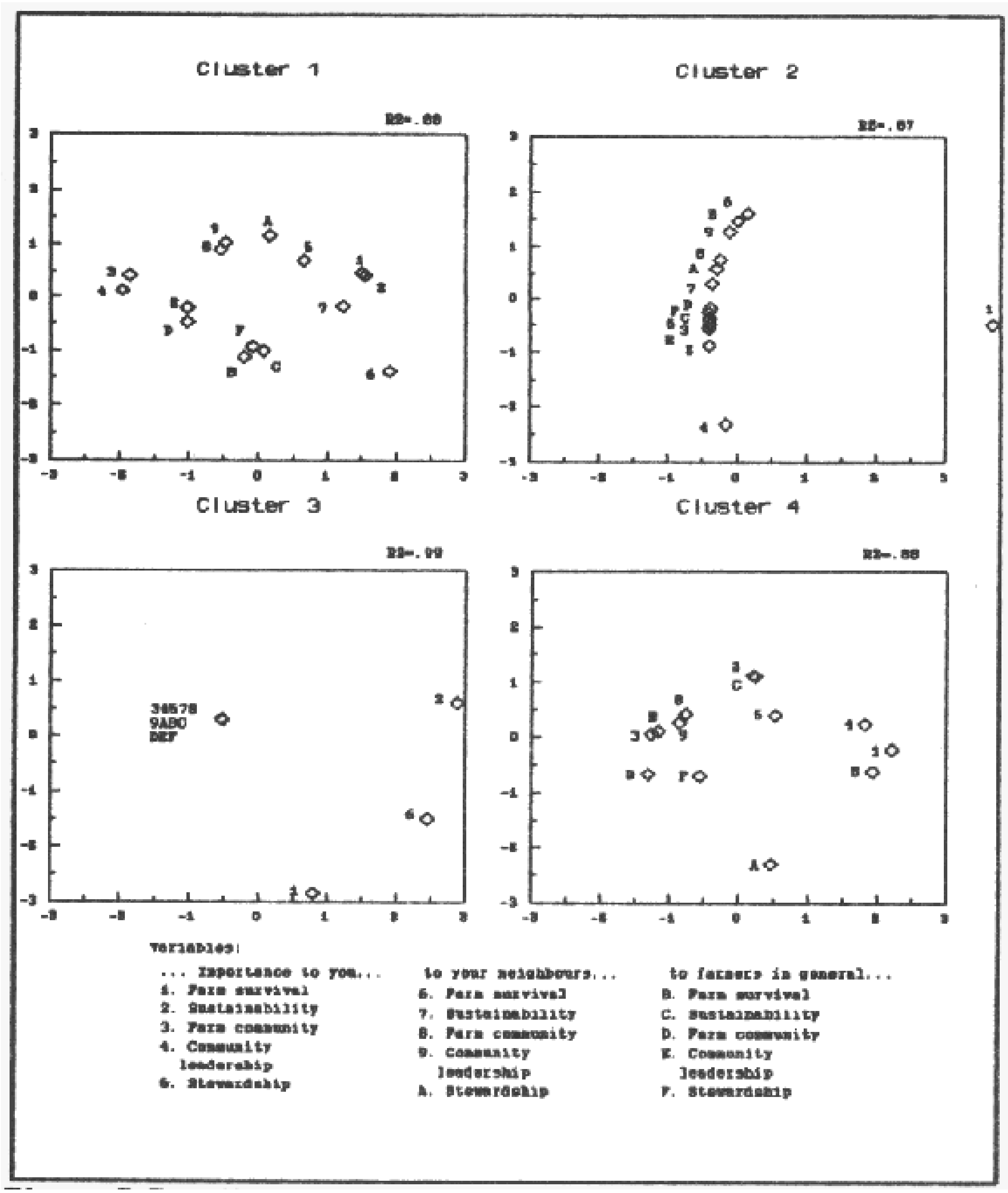

Figure 5. Two-dimensional constructs of motivation by cluster

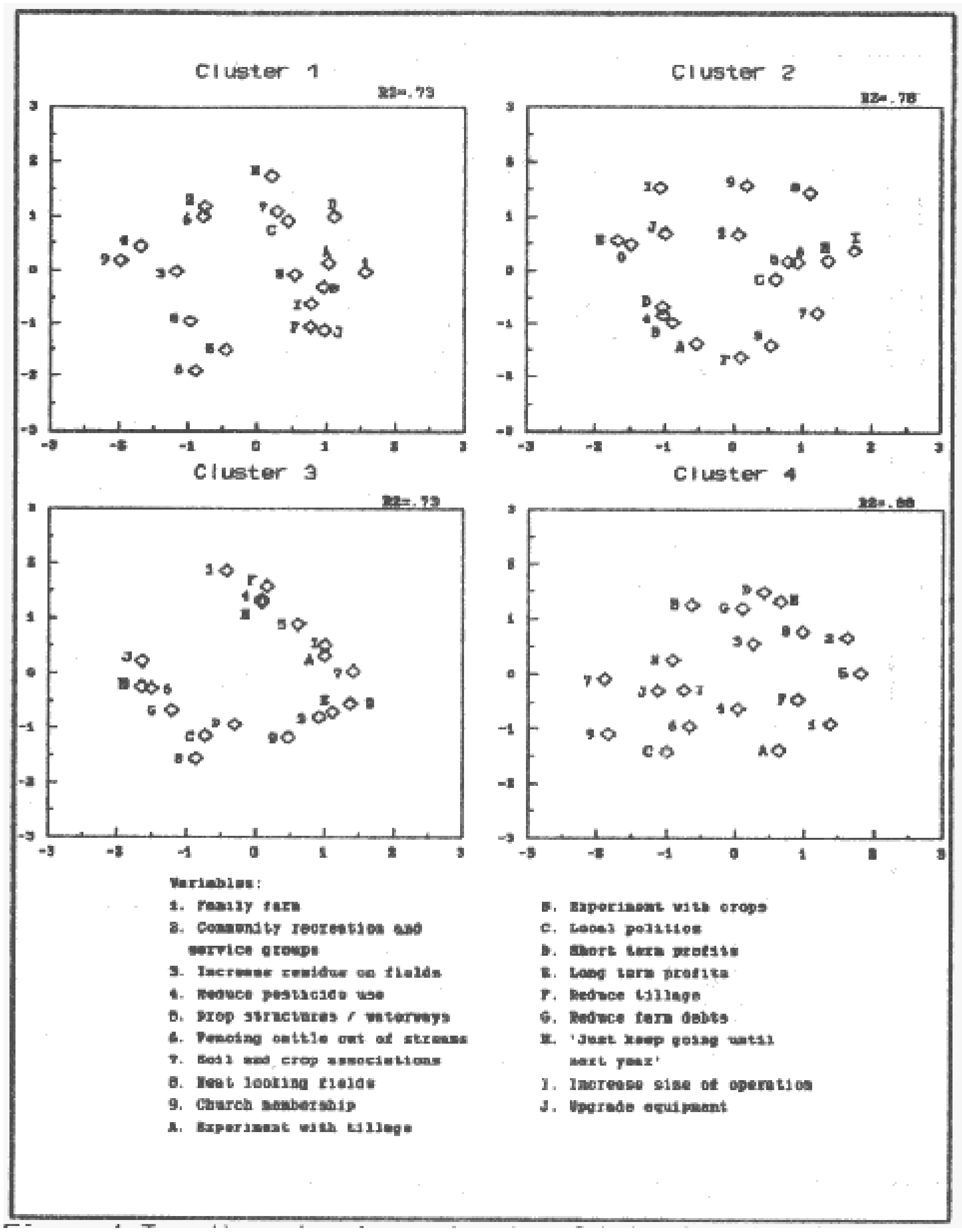

Figure 6. Two-dimensional constructs of behaviour by cluster

4.3 Constructs of Motivation

In this section three sets of five variables are mapped. Variables are farm survival, sustainability, farm community, community leadership, and stewardship. The first set of these variables; survival 1, sustainability 1 etc. refer to the importance of these variables to the respondent personally. The second set; survival 2 etc. refer to the respondent's perception of the importance of these variables to his or her neighbours. Finally, the third set represent the respondent's perception of the importance of these variables to farmers in general. On the figures for these constructs, variables are abbreviated to their first four letters, hence 'SUST-2' represents 'the respondents perception of the importance of sustainability to neighbours'.

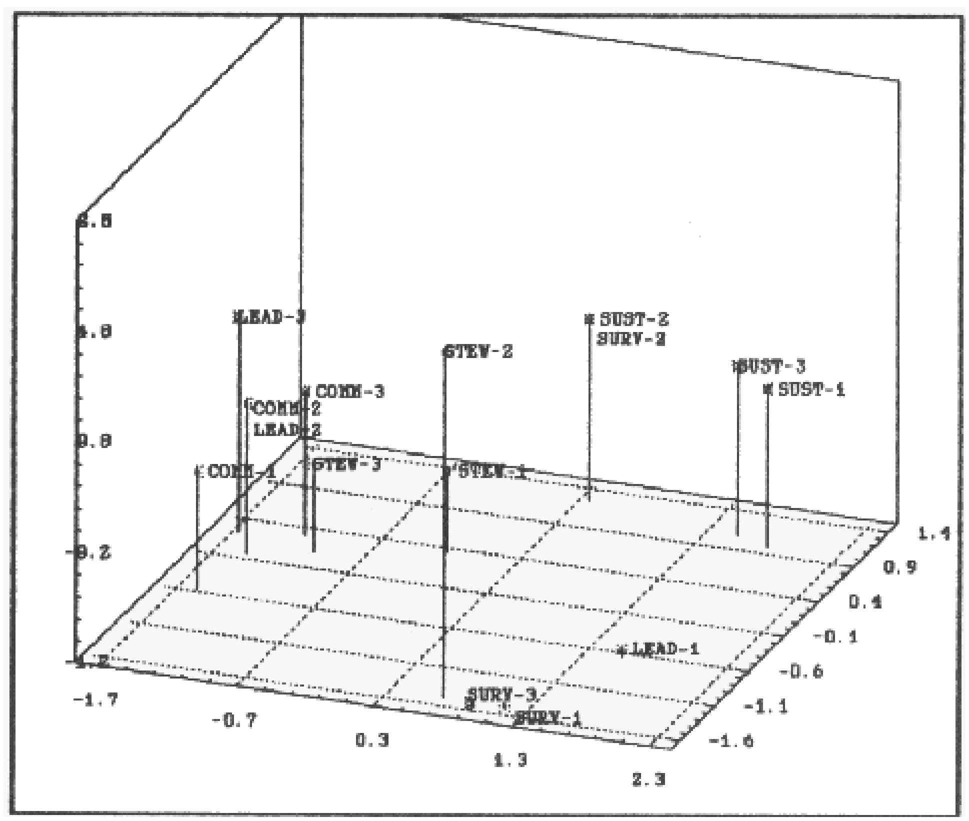

Figure 7. Cluster 1: Motivational variables scaled in 3 dimensions

In cluster 1 (Figure 6) community 1, 2, and 3, leadership 2 and 3, and stewardship 3 occupy one tight group which is at one end of the construct. Stewardship 1 is closest to the centre of the axes.

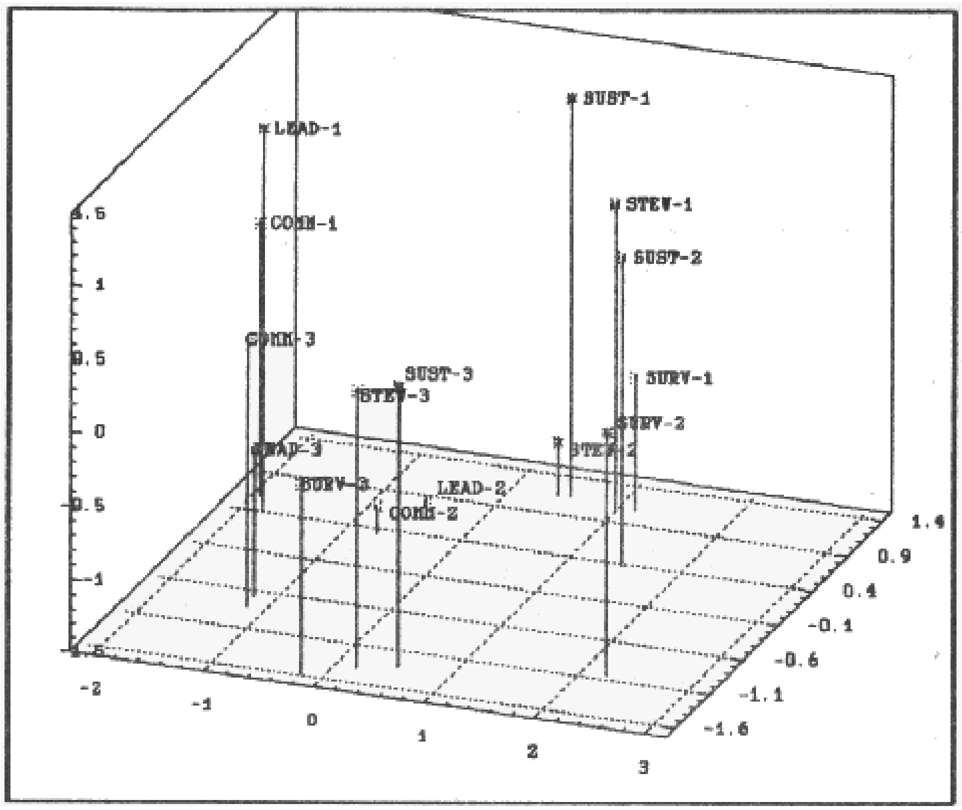

Figure 8. Cluster 2, Motivational variables scaled in 3 dimensions.

Cluster 2 (Figure 7) lacks the tight clustering of community and leadership variables as seen in cluster 1, but shows more readily discernible axes. As with cluster 1 community and leadership variables tend toward one end of the construct. However in this case, community 1 and leadership 1 are separated from community 2 and 3 and leadership 2 and 3. It appears that dimension 2 is based on the distinction between self, neighbours and farmers in general. Somewhat more clearly than in cluster 1, dimension 1 appears to represent survival and sustainability versus community, while stewardship falls in the middle.

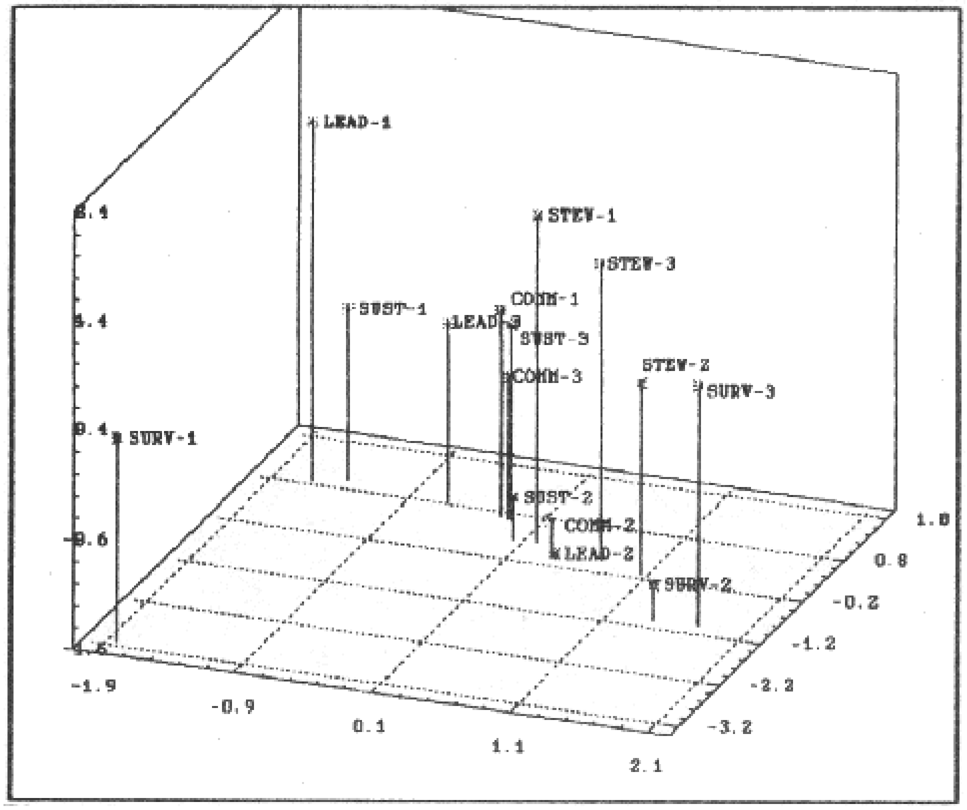

Figure 9. Cluster 3: Motivational variables scaled in 3 dimensions

Cluster 3 (Figure 8) appears to be dominated by survival 1. It is unclear as to whether dimensions 1 and 2 represent two discrete dimensions or one dimension on a curve. The major part of the curve -- that which contains all elements except survival 1 -- represents a continuation of the community versus survival trend present in clusters 1 and 2. In this case however, sustainability has moved from its association with survival to the opposite end of the scale. Survival 1 represents either a distant extension of a horseshoe-shaped formation (Kruskal & Wish, 1978), or a second dimension representing personal survival versus everything which is not personal survival. Dimension 3 also shows a discernible trend in this construct. Similar to dimension 2 in cluster 2, this dimension places the respondent and farmers-in-general in the upper and middle end, while neighbours occupy the lower end. In both cluster 2 and 3, stewardship 2 defies this tendency in that it is more closely associated with the personal and farmers-in-general end of the scale.

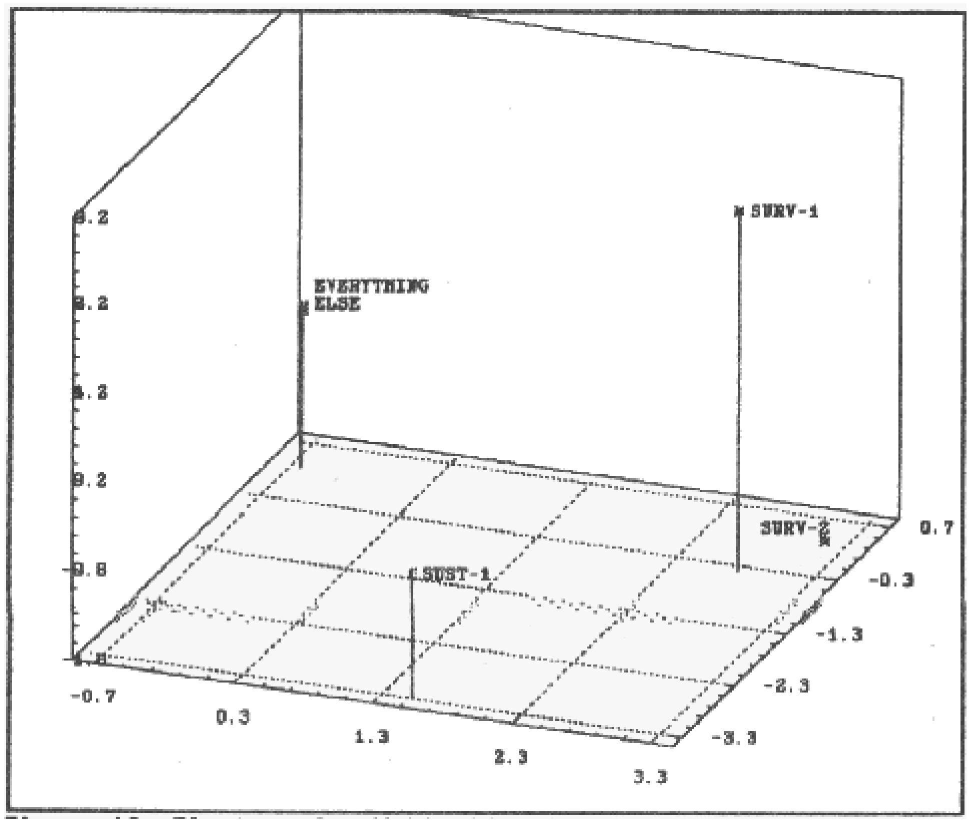

Figure 10. Cluster 4: Motivational variables scaled in 3 dimensions

Cluster 4 (Figure 9) shows a very strong polarization. all variables with the exceptions of survival 1 and 2 and sustainability 1 occupy the same space. This suggests that of the 15 variables, only the distinct three have any effective definition at all.

4.4 Constructs of Behaviour and Practices

In this section, constructs of behaviour will be considered with regard to variables of which are closely linked to conservation tillage. There were three such questions asked in this study, they are; 'the importance of experimenting with new tillage techniques', 'the importance of reducing tillage', and 'the importance of increasing crop residue and trash on fields'. In an ideal situation, we may expect these variables to map very closely together.

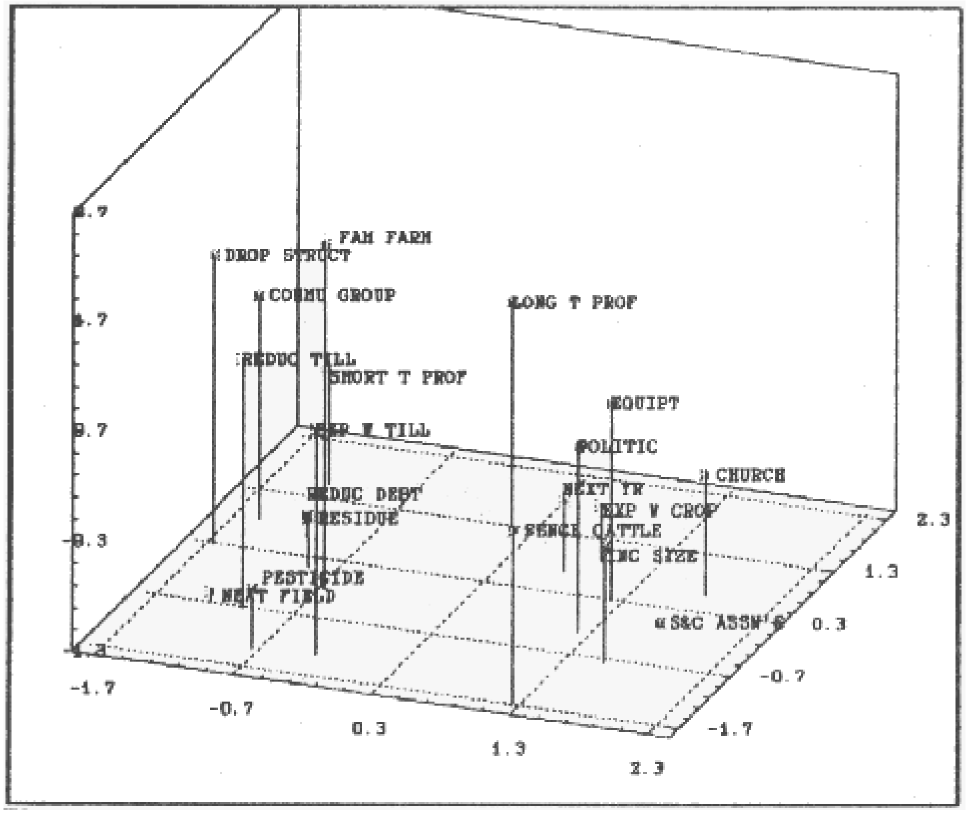

Figure 11. Cluster 1: Behaviourial variables scaled in 3 dimensions

In cluster 1 (Figure 10), the three conservation tillage variables are only very loosely grouped. along with 'the importance of reducing pesticide use', 'experimenting with tillage' is opposite to 'the importance of increasing long term profits'. 'Reducing tillage', with the importance of membership in soil and crop associations' is opposite 'the importance of keeping the farm in the family'. Finally, 'crop residue' is nearby 'the importance to reducing debts' and 'reduce tillage'.

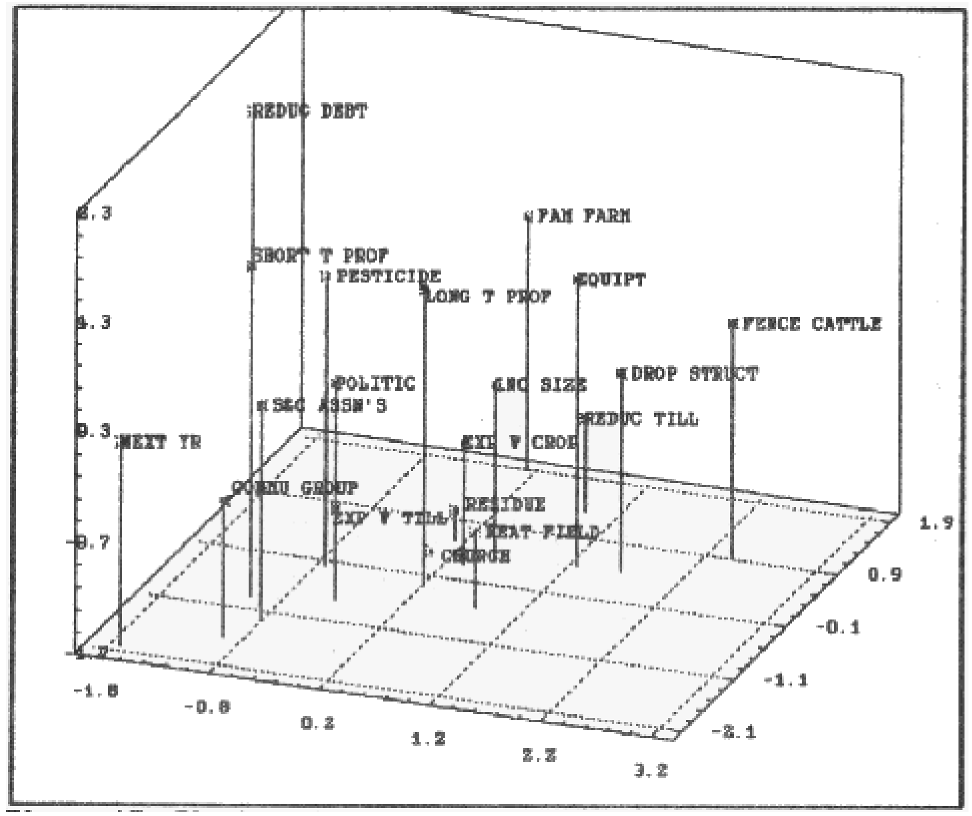

Figure 12. Cluster 2: Behaviourial variables scaled in 3 dimensions

The conservation tillage variables in cluster 2 (Figure 11) are also very loosely grouped. 'Experiment with tillage' along with 'family farm' is opposite church. 'Reduce tillage' with 'soil and crop associations' is opposite 'the importance of increasing the size of your operation'. 'Trash on fields' is more centrally located within the construct, and is nearby 'reduce tillage', 'reduce pesticides', and 'church'.

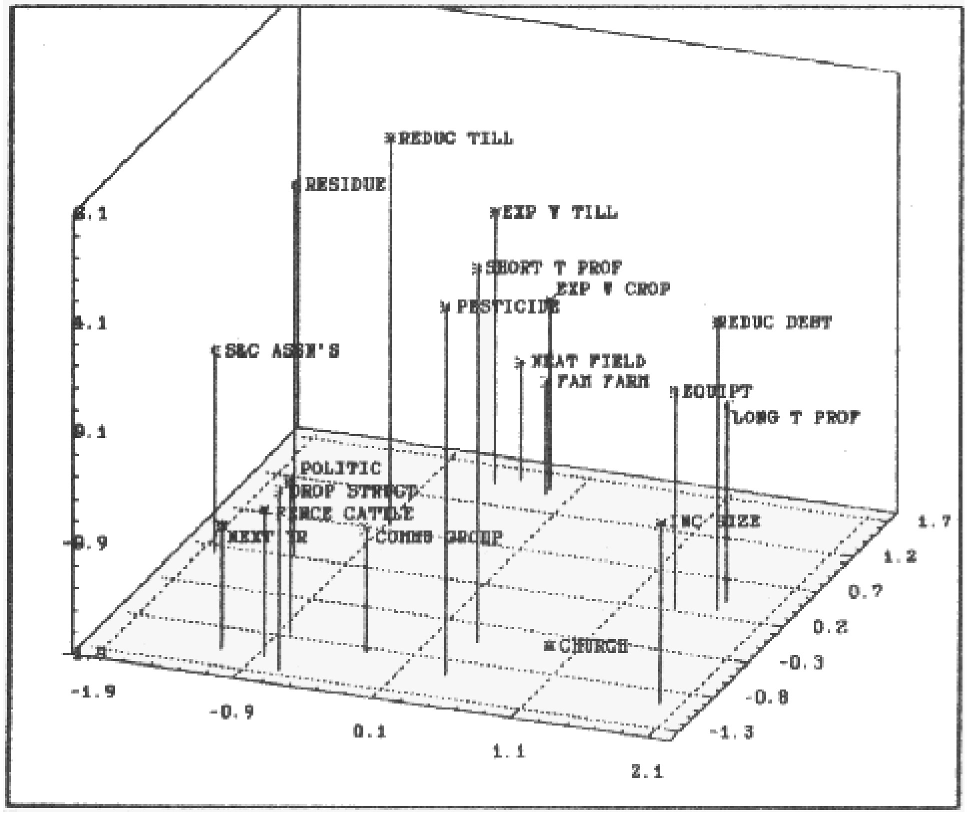

Figure 13. Cluster 3: Behaviourial variables scaled in 3 dimensions

Cluster 8 (Figure 12) shows a much tighter grouping of farm practices, 'experiment with tillage', 'reduce tillage', and 'trash on fields' are closely grouped, and nearby to 'experiment with new crops and hybrids', 'neat fields', and 'family farm'.

In cluster 4 (Figure 13) the conservation tillage variables fall moderately close to each other, and are within a larger group of variables. 'Experiment with tillage' is close to 'soil and crop associations' and 'the importance of involvement with community service and recreation groups'. 'Trash on fields' is nearby 'reduce tillage' and 'church'.

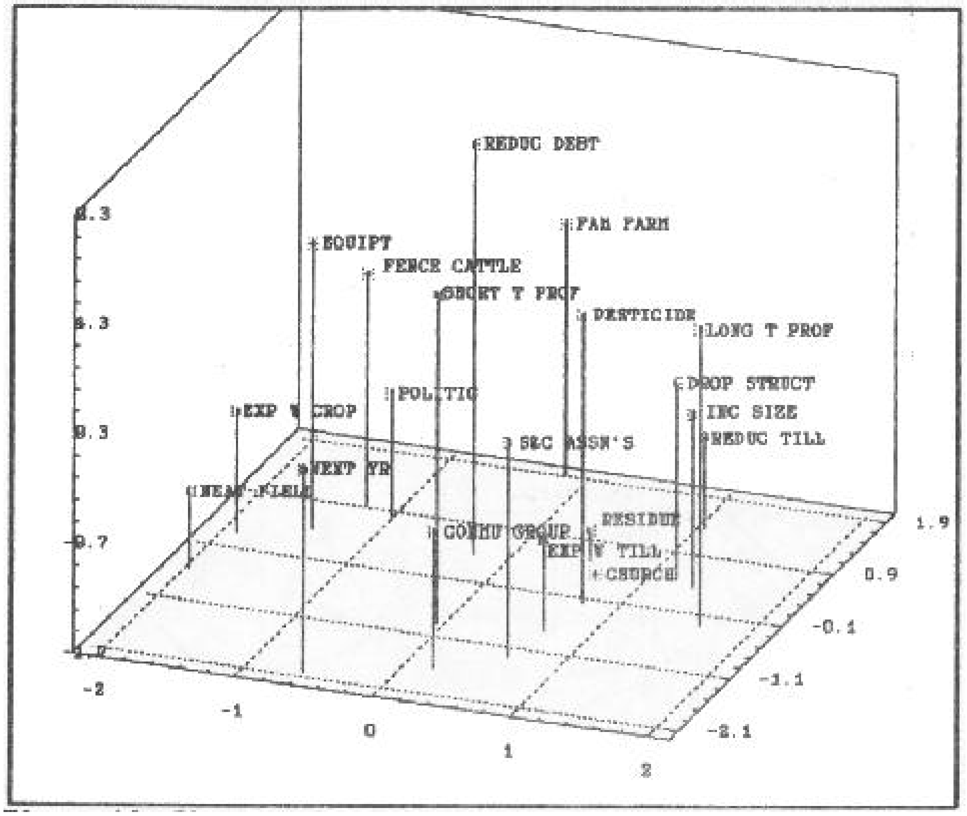

Figure 14. Cluster 4: Behaviourial variables scaled in 3 dimensions

4.5 Identification of Groups

In this section, socio-economic data, and measures of practice will be examined in order to determine differences between the four clusters, and if possible, to identify them. In effect, this process acts as a method of validity testing for the original process of clustering and scaling since the variables considered here were not used in the clustering. They form in effect, independent variables. Variables considered are; rotation, cropping, average number of tillage passes, tillage implements and timing used, water management practices used, aggregate score, number of conservation problems observed, age, education, farming experience, and farm size. Means for the full data set and for each cluster appear in Figure 1, mean values for practice appear on Figure 14 , and simple correlations appear on ? through Table V.

It is important to regard all of the results in this section with some care. In most cases, the high and low mean averages fall within no more than one standard deviation of each other. Furthermore, it should be remembered that cluster 1 has a size N of 8.

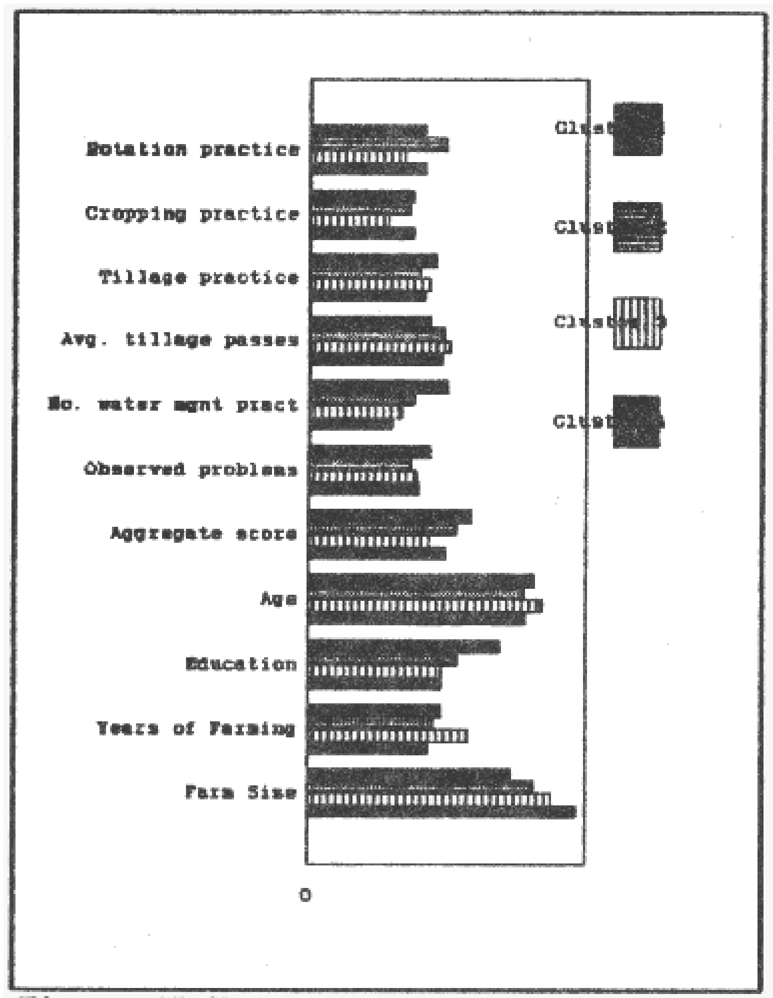

Figure 15. Farm Practice: Mean scores by cluster

Table III. Cluster 1: Means and correlation coefficients for behaviour and socio-economic variables

Variable	N	Mean	Std Dev
ROTATION	41	2.951220	0.973427
CROPPING	45	2.155556	0.998989
TILLAGE1	45	2.422222	0.583442
TILLAGE2	44	2.909091	0.960092
WATER	45	2.266667	1.601136
OBSERVED	42	2.214286	1.116084
SCORE	45	9.533333	2.408319
AGE	45	46.466667	14.060906
EDUCATION	45	3.200000	2.272364
EXPERIENCE	43	26.837209	15.826335
FARM SIZE	45	146.133333	52.453703

Correlation Coefficients / Prob > |R| under Ho: Rho =0 / Number of Obs

	ROTATION	CROPPING	TILLAGE1	TILLAGE2	WATER	OBSERVED	SCORE
AGE	0.121	0.138	0.216	-0.111	-0.028	-0.130	0.085
	0.44	0.36	0.15	0.47	0.85	0.41	0.57
EDUCATION	0.118	0.086	-0.150	-0.117	0.122	0.144	0.196
	0.46	0.57	0.32	0.44	0.42	0.36	0.19
EXPERIENCE	0.076	0.241	0.048	-0.051	-0.086	-0.060	0.077
	0.64	0.11	0.75	0.74	0.58	0.71	0.62
FARM SIZE	-0.279	0.343	0.098	0.221	0.055	0.091	0.188
	0.07	0.02	0.52	0.14	0.71	0.56	0.21

Cluster 1 is noteworthy as having the highest average education, and the lowest average acreage. This cluster has the highest overall conservation practice score, largely due to the high average number of water management practices in use. In addition, cluster 1 has the highest score for tillage practice, and the lowest estimated average number of tillage passes. Significant simple correlations include: age and tillage practice (-0.739 / .036 prob), experience and tillage practice (-0.740 / .036 prob), and farm size and estimated average number of tillage passes (-0.626 / .097 prob).

Table IV. Cluster 2: Means and correlation coefficients for behaviourial and socio-economic variables

Cluster 2: Socio-economic by Behaviour

Variable	N	Mean	Std Dev
ROTATION	19	2.052632	0.705036
CROPPING	27	1.703704	0.823446
TILLAGE1	27	2.629630	0.687702
TILLAGE2	27	3.037037	1.159625
WATER	27	2.000000	1.300887
OBSERVED	21	2.333333	1.316561
SCORE	27	7.777778	1.948043
AGE	23	50.434783	10.215078
EDUCATION	23	2.869565	2.701924
EXPERIENCE	23	34.521739	15.695597
FARM SIZE	27	157.333333	48.886840

Correlation Coefficients / Prob > |R| under Ho: Rho = 0 / Number of Obs

	ROTATION	CROPPING	TILLAGE1	TILLAGE2	WATER	OBSERVED	SCORE
AGE	0.313	0.018	0.021	-0.001	0.037	-0.330	0.079
	0.25	0.93	0.92	0.99	0.86	0.19	0.71
EDUCATION	0.051	0.140	-0.260	0.166	-0.106	0.445	-0.098
	0.85	0.52	0.23	0.44	0.62	0.07	0.65
EXPERIENCE	-0.032	0.084	-0.031	-0.015	-0.068	0.003	-0.044
	0.90	0.70	0.88	0.94	0.75	0.98	0.83
FARM SIZE	0.067	0.265	-0.406	0.202	0.473	0.306	0.302
	0.78	0.18	0.03	0.31	0.01	0.17	0.12

Cluster 2 represents the second smallest average farm acreage, and the highest rotation practice score. Otherwise, mean averages for this cluster are average. Two significant simple correlations are apparent. These are: cropping practice and farm size (0.344 / .021 prob), and rotation practice and farm size (-0.280 / .076 prob).

Table V. Cluster 3: Means and correlation coefficients for behaviourial and socio-economic variables

Cluster 3: Socio-economic by Behaviour

Variable	N	Mean	Std Dev
ROTATION	25	2.520000	0.653197
CROPPING	27	2.259259	0.813000
TILLAGE1	27	2.518519	0.752962
TILLAGE2	26	2.884615	1.107318
MATER	27	1.777778	1.187542
OBSERVED	23	2.391304	1.117592
SCORE	27	8.888889	1.739437
AGE	25	46.800000	14.352700
EDUCATION	24	2.875000	1.962972
EXPERIENCE	25	25.760000	13.169662
FARM SIZE	27	173.444444	37.889854

Correlation Coefficients / Prob > |R| under Ho: Rho =0 / Number of Obs

	ROTATION	CROPPING	TILLAGE1	TILLAGE2	WATER	OBSERVED	SCORE
AGE	0.268	0.163	-0.101	-0.025	0.025	0.032	0.271
	0.21	0.43	0.63	0.91	0.90	0.88	0.18
EDUCATION	-0.099	-0.122	0.193	0.135	-0.117	0.423	-0.155
	0.65	0.56	0.36	0.53	0.58	0.06	0.46
EXPERIENCE	0.355	0.198	0.011	-0.112	-0.094	-0.117	0.277
	0.09	0.34	0.95	0.60	0.65	0.61	0.17
FARM SIZE	0.160	0.063	-0.267	-0.013	0.037	0.148	-0.008
	0.44	0.75	0.17	0.94	0.87	0.49	0.96

Cluster 3 rates the lowest aggregate conservation score. This is largely due to low cropping and rotation practice scores and a high estimated average number of tillage passes. This cluster has the highest average age, the highest average years of farming experience, and the lowest average education. Significant simple correlations for this cluster are: farm size and tillage practice (-0.407 / .035 prob), farm size and average number of water management practices used (0.473 / .013 prob), and education and number of conservation problems observed on the farm (0.446 / .073 prob).

Table VI. Cluster 4: Means and correlation coefficients for behaviour and socio-economic variables

Cluster 4: Socio-economic by Behaviour

Variable	N	Mean	Std Dev
ROTATION	8	2.500000	0.534522
CROPPING	8	2.250000	0.886405
TILLAGE1	8	2.750000	0.462910
TILLAGE2	8	2.625000	0.916125
WATER	8	3.000000	1.309307
OBSERVED	8	2.625000	1.060660
SCORE	8	10.500000	1.851640
AGE	8	48.750000	13.562027
EDUCATION	8	4.125000	2.850439
EXPERIENCE	8	28.750000	19.804401
FARM SIZE	8	131.125000	57.707235

Correlation Coefficients / Prob > |R| under Ho: Rho =0 / N = 8

	ROTATION	CROPPING	TILLAGE1	TILLAGE2	WATER	OBSERVED	SCORE
AGE	0.492	0.505	-0.739	0.071	0.402	0.360	0.483
	0.21	0.20	0.03	0.86	0.32	0.38	0.22
EDUCATION	-0.234	-0,353	0.460	0.184	0.076	-0.171	-0.067
	0.57	0.39	0.25	0.66	0.85	0.68	0.87
EXPERIENCE	0.310	0.752	-0.740	0.427	0.418	0.545	0.560
	0.45	0.03	0.03	0.29	0.30	0.16	0.14
FARM SIZE	0.233	-0.313	-0.068	-0.625	0.115	-0.339	-0.018
	0.57	0.44	0.87	0.09	0.78	0.41	0.96

Cluster 4 shows the lowest average age, the lowest average education, the lowest average number of years of farming, and the highest average farm size. This cluster represents the lowest average number of water management practices in use, though it has a middling average aggregate conservation score. Two significant simple correlations are apparent for this cluster. They are: years of farming experience and rotation practice (0.355 / .096 prob) and education and number of conservation problems observed on the farm (0.424 / .063 prob).

5 Discussion

This chapter will present a synthesis of the data developed for each cluster in an attempt to identify them.

Cluster 1 is the group which shows the highest aggregate conservation practice score. This is based on having the highest average scores for cropping and tillage practice and number of water management practices used and the lowest estimated average number of tillage passes. Members of this group are slightly older than average, have the highest average level offormal education, and farm the smallest acreage.

Community and leadership are strongly associated motivational factors. Stewardship appears to fall somewhere between community/leadership and survival/ sustainability. The personal importance of stewardship is the motivational factor closest to the centre of the construct, while the perceived importance of stewardship to neighbours is associated with personal survival and leadership, and the perceived importance of stewardship to farmers in general is closely associated with community and leadership. This cluster shows the strongest construct of community, and appears to be furthest from the clusters which most strongly define survival. One may expect that members of this cluster are well established and relatively secure.

In spite of its indicators of good conservation practice, this group does not appear to strongly associate the importance of 'reducing tillage', 'experimenting with tillage' and 'increasing trash on fields'. This may correspond with the conclusions of Pampel and van Es (1977) who found that the theoretical indicators of innovativeness or positive disposition toward risk - - such as capital, farm size, sales, and education -- predicted the use of economically positive technologies, but did not predict the use of technologies that are environmentally positive, but economically neutral or negative. In this case, conservation tillage as a construct is not well formed even though good conservation practice is shown. Put slightly differently, Ervin and Ervin (1982) found that orientation toward risk was correlated with the number of conservation practices which an operator used, but not with perception of the degree to which erosion was a problem. That members of cluster 2 reported on average the highest number of conservation problems may slightly confound this suggestion, however it should be remembered that the measure in this study is the reported presence or absence of problems rather than the perceived degree of seriousness of the problem.

Cluster 2 represents a group which has a reasonably strong association between the importance of 'reducing tillage', 'experimenting with tillage' and 'increasing trash on fields', and 'the importance of increasing long term profits'. Furthermore, 'long term profits' and 'trash on fields' are veryclose to the centre of the construct.

For this group, farm size appears to have a significant simple correlation with rotation and cropping practices, though these correlations are somewhat contradictory with rotation practice being negatively correlated with farm size, and cropping practice being positively correlated.

This cluster has the highest average rotation practice score, yet an average aggregate conservation score of slightly above average for the full data set.

The construct of motivation for this group indicates differentiationbetween self, neighbours and farmers in general, and between survival/sustainability, stewardship, and community/leadership.

Cluster 3 shows the strongest association of 'reducing tillage', 'experimenting with tillage' and 'increasing trash on fields'. yet this is the cluster with the worst score for rotation and cropping practices, highest average number of tillage passes, and the lowest overall aggregate conservation score. This group is on average, the oldest, most experienced, and has the least amount of formal education. Members of this cluster appear to strongly distinguish the importance of farm survival personally from all other motivational variables, furthermore, they appear to make a strong distinction between themselves and their neighbours, while making little apparent distinction between themselves and farmers in general. For these farmers, sustainability is linked to community and leadership. Stewardship forms a 'central' concept (it is close to the centroid of the construct) and falls between community and survival.

The significant correlation between education and number of observed conservation problems for this cluster corresponds with Ervin and Ervin (1982) who concluded that age was correlated with the perception of environmental problems. Cluster 4 also shows this correlation, while clusters 1 and 2 – those with higher average levels of formal education – do not. While neither age nor education are strongly correlated with practice, this cluster is distinguished by age, education, and practice.

In terms of the adoption-diffusion model, this group may well represent late or non adopters; they are older and more experienced, and appear to construct conservation practices in a coherent fashion, yet they rank low in ratings of conservation practice. Two possible explanations are readily apparent. The strong motivational definition of survival suggests a hesitance toward risk; and the placement of conservation tillage oriented behaviours in a position which is opposite to reducing debts and long and short term profits suggests a belief that conservation tillage is not profitable.

Cluster 4 is on average, the youngest, least experienced group, farming the largest acreage, and having the least formal education. It is perhaps not surprising that the concept of survival should play such a strong part in the construct of motivation for this cluster. On average, members of this cluster show average or better rotation, cropping and tillage practices, although they use the lowest number of water management practices. It is quite likely that this cluster represents many of those farmers who are most financially stressed.

6 Conclusions

This study has provided an exploratory examination of perceptions and motivating factors in agriculture and conservation. Furthermore it has done so by demonstrating the application of personal construct theory and multi-dimensional scaling as theoretical and methodological bases for this examination.

The results of this study are not definitive, and additional studies using similar techniques are necessary in order to draw reliable conclusions regarding perceptions and motivation. However, this study yields several noteworthy results which will be discussed below.

6.1 Complex motivations in agriculture and conservation

It would appear that the structure of perceptions and motivation regarding agriculture and conservation is complex and variable. The current literature on agriculture and conservation, particularly studies based in the adoption/diffusion model have not reflected this complexity. This study has demonstrated that the use of personal construct theory and multi-dimensional scaling does present the capability of addressing such complexity.

6.2 The roles of Stewardship and Survival

Stewardship as ethic does not appear to be well developed as a source ofmotivation. In clusters 1, 2 and 3, where stewardship has reasonable definition, it consistently falls within the middle region of an axis which has survival at one end, and community and leadership at the other. In other words, we may consider stewardship as being viewed as a normative idea, or 'the thing that farmers do' rather than the antithesis of economic behaviour. Furthermore, stewardship does not appear to strongly differentiate groups of farmers.

The concept of farm survival appears to have dominated the process of clustering; the four clusters or groups are discernable by the degree to which survival is differentiated from other motivational variables. Put differently, of all the sources of motivation evaluated by farmers in this study, farm survival at the personal level appears to be the most significant.

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Appendix I: Study Questionnaire

Ontario

Dear

I am a graduate student at the University of Guelph, and I am studying conservation policy and agriculture.

I am conducting a survey of motivation for conservation among farmers. I am trying to determine what is important to farmers today, and what farmers consider when making farm management decisions. You would help me greatly by completing the attached survey and returning it to me.

The Ontario Institute of Pedology has provided me with the results of the 1983 Soil Management Survey in which you were a participant. This is why today's questionnaire is so short. Please remember that your answers are confidential.

Due to the number of farmers who I am contacting, this questionaire does not provide room for detailed opinions, but if you wish to provide additional comments regarding what you consider to be important, please do so in the space provided.

Thanking you in advance for this favor.

Yours Sincerely

Stephen Connolly
Department of Land Resource Science
University of Guelph
Guelph, Ontario

In this questionnaire five sources of motivation are described. They are outlined below. Please read them carefully. If you disagree with any of these definitions, or wish to change or add to them, please do so using the space provided.

- **farm survival: making** sure that you still operate your farm next year, and that it is still productive and economically viable

- **sustainability:** making sure that your farm will still be productive and economically viable over the next ten to twenty years

- **farm community:** being part of a farm community, being known and liked by your neighbors and being involved in community activities with friends and neighbors

- **community leadership**: being respected in the community and helping to form opinions and organize activities

- **stewardship:** the moral, ethical, or religious dimensions of farm practice which make us responsible for the well-being of the land

If you wish to add to or change these definitions please do so below.

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1. Please rate the importance of these sources of motivation to you.(circle one per line)

	very important		moderately important		not important
farm survival	1	2	3	4	5
sustainability	1	2	3	4	5
farm community	1	2	3	4	5
community leadership	1	2	3	4	5
stewardship	1	2	3	4	5

2. In your assessment, how important are these sources of motivation to your immediate neighbors?

	very important		moderately important		not important
farm survival	1	2	3	4	5
sustainability	1	2	3	4	5
farm community	1	2	3	4	5
community leadership	1	2	3	4	5
stewardship	1	2	3	4	5

3. How important do you feel these sources of motivation are to Ontario farmers?

	very important		moderately important		not important
farm survival	1	2	3	4	5
sustainability	1	2	3	4	5
farm community	1	2	3	4	5
community leadership	1	2	3	4	5
stewardship	1	2	3	4	5

4. Please rate the importance of the following practices to you.(please circle one per line)

	very important	moderately important		not important	
How important is it to you to keep your farm in the family ?	1	2	3	4	5
How important is participating in community recreation, or service groups to you ?	1	2	3	4	5
How important is it to you to increase trash or crop residue on your fields ?	1	2	3	4	5
How important is reducing pesticide use to you ?	1	2	3	4	5
How important is building or maintaining drop structures and grassed waterways to you ?	1	2	3	4	5
How important is fencing cattle out of streams to you ?	1	2	3	4	5
How important is membership in county soil and crop associations to you ?	1	2	3	4	5
How important is it to you to have neat looking fields ?	1	2	3	4	5
How important is membership in a local church to you ?	1	2	3	4	5
How important is it to you to experiment with new tillage techniques or equipment ?	1	2	3	4	5
How important is it to you to experiment with new crops or hybrids ?	1	2	3	4	5
How important is involvement in local politics to you ?	1	2	3	4	5
How important is it to you to increase short term profits ?	1	2	3	4	5
How important is it to you to increase long term profits ?	1	2	3	4	5

	very important		moderately important		not important
How important is it for you to reduce tillage ?	1	2	3	4	5
How important is to you to reduce farm debts ?	1	2	3	4	5
How important is it to you to just keep the farm going until next year ?	1	2	3	4	5
How important is increasing the size of your farm operation to you ?	1	2	3	4	5
How important is it to you to upgrade equipment ?	1	2	3	4	5

would you like to add anything which you consider to be important ?

________________________________	1	2	3	4	5
________________________________	1	2	3	4	5
________________________________	1	2	3	4	5
________________________________	1	2	3	4	5

5. Have you made any major changes to your operation since 1983 ? (changes in acreage, major crops, stock, tillage practice, or structures) if so what?

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(use the back of this sheet if necessary).

6. Please check the category which describes your age

under 25 __ 26-35___ 36-45 ___ 46-55 ___ 56-65 ___ over 66 ___

7. How much formal education have you had? (please check one)

grade 8 ___ some high school ___ finished high school ___

extension courses ___ agricultural diploma ___

some university ___ university degree ___

self educated (read extensively) ___

8. Do you get information from other sources such as agricultural extension, the library or farm reports? (please specify)

____

____

8. How long have you farmed for ______

9. Your turn; do you wish to add any comments about what is important to you, or about this questionnaire?

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Thank you for taking the time to finish this questionnaire,
I appreciate your help.