FRAMEWORK AND REVIEW OF CAPACITY AND MOTIVATION FOR CHANGE TO SUSTAINABLE MANAGEMENT PRACTICES

FINAL REPORT

THEME 6: PROJECT 6.2.1

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EXECUTIVE SUMMARY

The objective of this report was to develop and operationalise a framework for identifying indicators of the motivation and capacity of farmers and land managers to implement change towards sustainable land and water management practices. The framework had to be conceptually and theoretically grounded in previous research, while at the same time indicators within the framework had to be identifiable from existing data sets and able to be applied to a number of Audit projects.

The concept of sustainability was identified as an emerging social norm that is in the process of being formalised and legitimised through institutions and institutional processes throughout Australia. Recognising sustainability as a normative standard of environmental behaviour and belief, which is 'diffused' throughout the community through formal and informal institutional processes emphasises not only the capacity of individuals to adopt sustainable practices, but also the broader social context in which the adoption of sustainable practices occurs.

A review of research within the adoption-diffusion research paradigm indicated that many of the variables and constructs used to predict behaviour change at the farmer and land manager level had been operationalised in terms of the characteristics of individual farmers and farming enterprises. While there had been considerable research which had identified individual farmer and farm characteristics important in the adoption of sustainable practices, much of the early adoption-diffusion research had also emphasised the social context of adoption and in particular the role of social norms.

A conceptual framework was developed in which a number of indicators were embedded. This framework was based on a review of the empirical and conceptual research within the adoption-diffusion paradigm together with a recognition of sustainability as a social norm and the role of institutional processes in the diffusion of this normative standard.

The three component framework that has been developed has a theoretical and conceptual basis, while at the same time is:

(a) generally applicable to a number of farming types;
(b) is able to be applied at a regional or sub-regional level;
(c) relies primarily on secondary data sources;
(d) is parsimonious in terms of its general application and use;
(e) provides important information for policy development, and
(f) is broadly applicable to a number of Audit projects.

One component of the framework, consisting of **individual indicators**, includes indicators of motivation and capacity. These indicators had consistently been identified in the research as important predictors of behaviour change towards sustainable land management practices. They included:

(a) the age of the farmer or land manager;
(b) years of farm management experience;
(c) farmer education and skill levels;
(d) the number of farm family members working on farms;
(e) level of farm income;
(f) level of farm debt;
(g) level of farm profit;
(h) farm size;
(i) farm ownership;
(j) farm enterprise mix, and
(k) employment of non-family labour.

The second component within the framework consisted of **institutional indicators**, representing the occurrence, prevalence and characteristics of farm related and environmental institutions within a region or farming community. Formal and informal institutions in this context provide a basis for the diffusion of social norms and capacity building within communities in meeting the objectives of sustainability. Institutional indicators included:

(a) the number, distribution and membership size of formal institutions;
(b) inter-farm density;
(c) farm remoteness, and
(d) access to media.

The third component within the framework consisted of **appraisal indicators** and represents broadly the level of participation in institutional processes. The indicators are represented as appraisal indicators in so far as active institutional participation is also likely to be associated with the appraisal of land degradation and a recognition of the need to adopt sustainable land management practices. Appraisal indicators included:

(e) group membership,
(f) length of group involvement, and
(g) level of contact with extension, advisory, training, Landcare and other programs.

A review of data sources for the indicators showed that the majority of indicators could be derived from three secondary data sources which included the ABS Population and Housing Census, the ABS Agricultural Census/Commodity Survey and the Australian Agriculture and Grazing Industry Surveys and supplementary surveys undertaken by ABARE. Importantly, indicators derived from these sources allowed time series analyses to be undertaken, forward monitoring of changes in the indicators and a national coverage at the SLA level or aggregation of several SLAs. While the majority of indicators could be derived from secondary data sources several of the institutional and appraisal indicators would require data drawn from both secondary and primary data sources.

Prior to the implementation of the framework it is argued that pilot or feasibility research needs to be undertaken in order to:

(a) examine the effectiveness of the indicators as predictors of change towards sustainability practices;
(b) to provide an indication of the salience or relative importance of the indicators, and
(c) to address methodological and analytical issues associated with data collection and analysis.

The framework and associated indicators are discussed in terms of their integration with other economic and biophysical information using a GIS platform and project tasks are identified in relation to the implementation of Audit Project 6.2.2.

1. INTRODUCTION

The National Land and Water Resources Audit is an initiative under the Natural Heritage Trust. The aim of the Audit is to provide information to help natural resource managers to assess and develop policy; decide on investments; evaluate program and policy performance; and to direct resource management, particularly by government.

The Audit is focussing primarily on rural and remote natural resources that are managed for a range of production and conservation uses, and will assess, as comprehensively as possible, the environmental and socio-economic aspects of land and water resources for all land tenures.

The objectives of the Audit are to facilitate improved decision making on land and water resource management by:

- providing a clear understanding of the status of, and changes in, the nation's land (including vegetation) and water resources and implications for their sustainable use;
- providing an interpretation of the costs and benefits (economic, environmental and social) of land and water resource change and any remedial actions;
- developing a national information system of compatible and readily accessible land and water data;
- producing national land and water (surface and groundwater) assessments as integrated components of the Audit;
- ensuring integration with, and collaboration between, other relevant initiatives; and,
- providing a framework for monitoring Australia's land and water resources in an ongoing and structured way.

Through an assessment of the needs of natural resource managers, seven themes for consideration by the Audit were developed. A theme represents a group of related natural resource management questions and issues. Each theme covers socioeconomic issues and problems associated with a specific aspect, or combination of water, land and vegetation. The seven themes include:

1. Surface and groundwater management, including the availability, allocation, use and efficiency of use
2. Dryland salinity
3. Vegetation cover, condition and use
4. Rangelands monitoring
5. Land use change, productivity, diversity and sustainability of agricultural enterprises
6. Capacity of, and opportunity for farmers and other natural resource managers to implement change
7. River, estuary, catchment and landscape health

Theme 6, the focus of this document, will include the collection of social and economic information. As management practices, natural resource policies, incentives, regulations and investment all play a role in progress towards sustainability, assessing their effectiveness will help decision-makers formulate improved responses to natural resource management issues.

Theme 6 will assess the capacity for Australia's natural resource managers, State, Territory or individual managers, to implement changes oriented towards the improvement of social, economic and environmental sustainability. It is anticipated that information on natural resource management practices, social 'drivers' of change and opportunities and mechanisms to implement sustainable natural resource management will be collected and assessed in this theme.

The overall objective of the current project is to develop a comprehensive framework for assessing change in resource management and to provide a summary of what is known about change, including the motives and capacities for farmers and land managers to implement change. The focus is on change towards more sustainable and beneficial land, vegetation and water management practices and will provide the necessary framework for projects within the Audit and elsewhere that integrate biophysical, economic and social components within a natural resource management context.

This project has two primary objectives. The first objective is to develop a conceptual framework, which will allow the identification of specific indicators which are regarded as effective predictors of the capacity of farmers and other land managers to adopt change management regimes towards more sustainable land management practices. The second objective is to examine ways in which the conceptual framework maybe operationalised, in terms of:

(a) the development of specific social and economic indicators,
(b) data requirements for indicator development,
(c) the application of indicators at a national scale,
(d) the establishment of a monitoring framework for these indicators, and
(e) techniques and processes which will allow the useful integration of social, economic and biophysical indicators.

The framework that is developed has to be sufficiently generic that it may also be applied to other Audit projects including those projects based on primary data collection, including survey research, and those projects where the methodology is based on secondary indicators research. Additional Audit projects in which the framework and indicators may also be applied include:

Project 6.1.2 Costs of Resource Degradation to Agriculture, which includes an ABARE survey that will address specific issues related to the capacity of broadacre farmers' capacity to change.

Project 6.2.2 Integrated Socioeconomic and Biophysical Database System for Sustainable Management, which includes the development of a GIS platform, as a means of integrating social, economic and resource data relevant to understanding the capacity of individuals and communities to respond to and implement change towards sustainable land and water management.

Project 6.3.1 Dairy Industry Case Study, which includes the identification of capacities of dairy farmers to change, industry attitudes, motivation and constraints to adoption of improved practices that benefit both production and environmental sustainability.

Project 6.3.2 Horticulture and Environmental Audit, which includes the capacity of industry members to adopt sustainable practices.

Project 6.3.3 Case Study of Dryland Salinity and Watertable Control which includes an investigation of the capacity to increase recharge control within existing agricultural structures, land uses and management practices; the capacity to change to land uses for particular land systems that reduce recharge; and to respond to dryland salinity by investment in discharge control.

Of particular importance to the current project is Audit project 6.2.2, which is to develop an integrated socioeconomic and biophysical database consisting of indicators relevant to understanding the capacity of farmers and land managers to change towards sustainable land management practices. The framework and indicators developed in the current project should provide the basis for indicator selection and assessment within Audit project 6.2.2.

The methodology used in addressing project objectives has included:

- a review of the national and international research literature, (b)

- a workshop with the Queensland Theme 6 Demonstration Project team members,
- a workshop with individuals from Agriculture Forestry and Fisheries Australia, Environment Australia and the Bureau of Rural Sciences, and
- individual discussions with personnel from State and Commonwealth agencies and departments in relation to the identification and use of available datasets.

1.1. PROJECT OBJECTIVES

This project has seven core objectives which are described below. The objectives have been grouped under three headings, which include (a) framework development, (b) framework operationalisation and (c) integration and application.

Framework Development

1. Build upon the conceptual work already commenced in the Queensland Theme 6 demonstration project and develop a theoretical and conceptual framework for considering capacity to change towards sustainable land and water management practices;
2. Within the framework, identify specific attributes or constructs which are theoretically and conceptually identifiable as core predictors of capacity to change;

Framework Operationalisation

3. Review existing data sets and identify their potential, including their strength and weaknesses, to be used as indicators for constructs within the framework;
4. Provide and recommend appropriate methods and procedures that could be implemented to resolve data requirements in the implementation of the framework;

Integration and Application

5. Describe and recommend modelling or analytical approaches for integrating social data with resource, economic and biophysical data sets;
6. Provide specific directions for the implementation of project 6.2.2; and
7. Recommend how social data sets and the recommended approaches to modelling and integration might be used in decision support and policy development.

2. FRAMEWORK DEVELOPMENT

Conceptual frameworks are ultimately ways of organising information in relation to a specific topic or concept of interest (Hamilton & Attwater, 1997). In a discussion of the application of an integrated human ecosystems approach to ecosystem management, which includes social, economic and biophysical indicators, Force and Machlis (1997) argue that such a framework "should be

(1) derived from theory and empirical studies,
(2) relevant to a wide range of resource management conditions,
(3) applicable at various temporal and spatial scales, and
(4) able to explicitly link social and biological systems" (p. 373).

The approach used in the development of a conceptual framework in the current research adopts the criteria specified by Force and Machlis (1997), with the additional criteria that the framework needs to specify indicators which are capable of being quantified using existing data available from secondary sources. The framework needs to be applicable to a number of resource management contexts and conditions; should allow temporal, geographic and industry sector comparisons and should be broadly applicable to a number of Audit themes. Given this, the framework must be relatively generic in relation to the specification of indicators while at the same time maintaining a high level of conceptual and theoretical integrity.

2.1. REVIEW OF QUEENSLAND THEME 6 DEMONSTRATION PROJECT

As part of the Theme 6 Demonstration Project, a review of the literature was undertaken in order to identify the capacity of and opportunity for farmers[1] and other land managers to implement change at the property, community and regional level (Coakes, Fenton & Lockie, 1999). This review had a number of core objectives, which included:

- To critically review the theoretical literature on modeling capacity building and linking such models to policy and planning processes at the national, regional, community and property levels;
- The development of a common theoretical base for modeling capacity to change and for evaluating potentially useful indicators;

[1] *When used throughout this report the term farmer also includes land manager and or farm manager.*

- A review of the full range of potential indicators that may contribute to the development of the theoretical model at the tactical and operational levels;
- The establishment of key criteria for exploring the potential value of the indicators in the development of nationally applicable models at these levels. Critical issues that were considered included: (a) the need to ensure indicators are closely linked to national data sets; (b) the need to take advantage of existing data collection activities; (c) the need to ensure that indicators have a demonstrable theoretical link between cause and effect; (iv) cost effectiveness, sensitivity and user-friendliness.

The core project objectives of the Queensland Theme 6 Demonstration Project and the current Audit project are by no means identical. In particular, and given the requirements of the project being undertaken in the Fitzroy region of Queensland, the Queensland Theme 6 Demonstration Project attempted to address questions related to capacity building at a community level in addition to the identification of specific social indicators of `capacity to change' towards sustainable land management practices.

The principle outcome of the Queensland report (Coakes et al. 1999) was the development of a four component model of capacity to adopt sustainable land management practices, which included indicators at the individual and community levels and indicators related to the appraisal of sustainable land management practices. However, one of the problems recognised in the Queensland Demonstration Project was that while it was possible to identify indicators which were theoretically related to community and environmental sustainability, there was considerable difficulty in identifying existing data sets which could be used as a basis for the development of such indicators. As such many of the indicators that were identified could not be developed or could only be developed through very intensive survey and field research. Clearly one of the implications for the current project is that while theoretically sound indicators must be developed, there also should be concurrent consideration given to what data sources are to be used in the development of these indicators. Without a dual consideration of both issues, the project is in danger of having either very elaborate theoretical and conceptual models without data, or of having considerable data which has little value in the prediction of capacity to change towards sustainable land and water management practices. The approach adopted in the current study has been to give equal and concurrent consideration to both the theoretical and conceptual basis for indicator selection and the pragmatic requirements of indicator development and implementation.

2.2. SUSTAINABLE LAND AND WATER MANAGEMENT PRACTICES

The concept of sustainability is often criticised for its ambiguity and multi-dimensional nature (Diesendorf, 1999; Jacobs, 1991; Pannell & Schilizzi, 1997). The core concept underlying sustainability can be traced back to the 1987 World Commission on Environment and Development (WCED), where sustainable development was defined as "development that meets the needs of the present generation without compromising the ability of future generations to meet their needs" (WCED, 1987).

Implied within WCED definition are the concepts of inter-generational and intra-generational equity. The latter refers to equity between existing generations, in so far as all members of society should have equal opportunity to reach a fulfilling a rewarding life, while the former extends the concept of equity to future generations.

Protecting the environment and biodiversity extends from the basic principle of inter-generational equity, in so far as we need to protect the environment now so that the capability of the environment to deliver a healthy lifestyle into the future is not compromised. However, there is also considerable uncertainty about what the needs of future generations will be. For example, there is uncertainty about the quantity and type of particular resources that will be needed, there is uncertainty about possible use functions of the environment that may yet have to be identified and there are uncertainties about the possible irreversibility of current decisions on opportunities in the future. These uncertainties are the basis of the precautionary principle, which was also given effect through the Rio Declaration of Environment and Development in 1992. In short, the Inter-Governmental Agreement on the Environment (IGAE) states that: "where there are threats of serious irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation" (Australian Government 1992a).

In response to the WCED report and the IGAE, all levels of Australian government committed themselves to a National Strategy on Ecologically Sustainable Development (NSESD). In short, "Ecologically Sustainable Development (ESD) means using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and quality of life for both present and future generations is increased" (Australian Government, 1992b).

It follows that if present economic activities, such as agriculture and pastoralism, are in some way depleting or impacting on non-renewable resources, then the present generation should either pay full compensation to future generations by way of bonds or assurances or at least prevent the loss from taking place in the first instance. It is generally accepted that the latter is the more realistic solution, and that both non-renewable and renewable resources should be protected as far as is possible.

Within the context of the natural resource industry, the NSESD identifies four aims related to sustainability. These are:

1. to facilitate the ecologically sustainable development of agricultural industries so that they contribute to long-term productivity and to Australia's economic well-being, protect the biological and physical base on which agricultural industries depend, and improve human health and safety;
2. to protect biological diversity and maintain ecological processes and systems;
3. to conserve and where appropriate, restore native vegetation to maintain and enhance biodiversity, protect river water quality and conserve soil resources, including on private land managed for agriculture, forestry and urban development;
4. to establish and enhance policy and administrative frameworks for environmental protection in which governments and the community can develop effective and efficient measures to achieve environmental objectives, while recognising the interrelationship with economic and social objectives.

The Natural Heritage Trust (of which, the Audit is a part) has been conceived and developed with these four aims underlying the development of specific programs. As such, the NHT acknowledges that:

> *"Australia's natural environment is central to Australia's health and non-material well-being and to Australia's present and future economic prosperity. Accordingly, present and future generations of Australians will benefit from the ecologically sustainable management of the natural environment" (NHT Act, 1997).*

It is perhaps noteworthy that the promotion of sustainable land management practices in Australia, has adopted the Landcare model, which is essentially a 'bottom-up' approach to the diffusion and implementation of new management practices and initiatives (Campbell, 1992).

The history of Landcare goes back to the early 1980s when investigations into land conservation identified three areas of activity. These were; education, financial incentives; and, legal guidelines and controls. These three formed the basis of a service provision model within the National Soil Conservation Strategy, which ultimately led the establishment of the National Soil Conservation Program (NSCP) in 1983. Later in 1992, the Soil and Land Conservation Act was repealed and replaced by the Natural Resources Management Act and as a result, the NSCP was subsumed into the National Landcare Program (NLP). The NLP has now been subsumed to become a sub-program of the Natural Heritage Trust (NHT).

The important historical point to note is that while the NSCP, the NLP, and now the NHT provide funding for Landcare activities, the Acts have also provided the jurisdictional process by which community groups may be

incorporated and so access such funding. Groups are seen as the most appropriate medium to work in under this model of extension (Marsh & Pannell, 1997) and perhaps one of the positive characteristics of the Landcare movement is the community response to the initiative. For example, the rate at which incorporated Landcare groups have been established nationally has increased almost at an exponential rate since the early 1980s. Latest estimates suggest that there are now almost 5,000 community Landcare groups across Australia extending to nearly all inhabitable parts of the continent (Knox, 1999).

Not only have sustainable land management practices been initiated through groups such as Landcare, but other more recent community based organisations such as Bushcare and Coastcare have also been initiated. Bushcare, which is administered through Environment Australia and delivered through the NHT, has three primary objectives which are to:

1. conserve, enhance and sustainably manage remnant vegetation;
2. increase and improve revegetation activities, and
3. encourage the integration of native vegetation into conventional farming systems.

Coastcare, is also a conservation under the NHT, which has its primary objectives to:

1. engender in local communities, including local industries, a sense of stewardship for coastal and marine areas;
2. to provide opportunities and resources for residents, volunteers, business and interest groups to participate in coastal management;
3. to support community identification of natural and cultural heritage resources; and
4. to facilitate interaction between the community and bodies with responsibility for managing coastal areas.

Membership of these groups has also increased steadily since the start of the various Landcare programs. However, while it seems evident that Landcare and other groups has been quite successful at raising the level of awareness of land degradation issues amongst farmers, the rate at which sustainable land management practices have been adopted has generally been slow (Vanclay & Lawrence, 1995). One of the objectives of the current project is to identify, through the development of social indicators, regional variations in the capacity of farmers and land managers to implement sustainable land management practices.

What is important in the context of the previous discussion in relation to sustainability, is the process through which beliefs and values congruent with sustainability have been formalised and legitimised through institutions and institutional processes throughout Australia. It is also important to recognise that these institutions at both a Commonwealth and State level and through community based initiatives, as found in the Landcare, Bushcare and Coastcare

programs, provide the institutional capacity for many individuals and communities to initiate sustainable land and water management practices. More fundamentally, these same institutions 'diffuse' or propagate at all levels of community the goals of sustainability to the extent that individual beliefs and behavioural actions are becoming increasingly congruent with sustainability as an emerging social norm and normative standard of behaviour.

2.3. SUSTAINABILITY AS A SOCIAL NORM

What Section 2.2 illustrates is that the concept of sustainability and the associated criteria on which sustainability is based, is ultimately one that is derived from government action and policy. The World Commission on Environment and Development (WCED), the Inter-Governmental Agreement on Environment (IGAE) and within an Australian context the National Strategy on Ecologically Sustainable Development (NSESD) and the National Heritage Trust (NHT) all prescribe the concept of sustainability.

It is argued that the prescription of sustainability by many government and non government agencies and groups represents a social norm which 'ought to' guide the behaviour and actions of farmers and land managers in relation to specific normative standards regarding the management of land and water resources. As Dressler (1969) has stated in his treatment of social norms, "a social norm defines the behaviour that a number of people ordinarily expect or require of others…the behavior defined by social norms is always accompanied by an element of "ought to " or "must" (p. 90). Clearly, the institutional representation of sustainability as a social norm is seen as guiding the actions and behaviours of farmers and land managers in so far as specific farmer and land manger behaviours, practices and actions "ought to" or "must" be undertaken if society is to meet the objectives of sustainability as articulated in that specific social norm.

If the concept of sustainability and its associated objectives and criteria, as broadly defined in Section 2.2 is recognised as a social norm, this partly overcomes what was otherwise a difficult and potentially intractable problem related to the definition of sustainability for the purpose of defining indicators of capacity. Vanclay (1998), reporting on a workshop on the inclusion of social data in the Australian Land and Water Audit, has certainly recognised a problem associated with the definition of sustainability, including the "meaning of sustainability in social terms…and problems associated with the social basis of, and value judgements about sustainability". There are many definitions of sustainability, many of which are based on individual's constructions, perceptions and beliefs rather than more formal normative definitions. In that case, such individual and differing constructions of sustainability have to be accounted for. As Vanclay (1998) states, the diverse views of sustainability as accepted by many farmers as being "me and my family on our farm in the future, and not the preservation of the environmental quality of the land".

If sustainability is defined as a social norm, the capacity of farmers and land managers to implement change towards sustainable land and water

management practices must not only include capacity defined in terms of individual resources (including for instance income levels, age, and educational level) but in addition, the extent to which farmers and land managers interpret the social norm, including their willingness to conform to the social norm of sustainability. This is an important consideration, which has been recognised in the Theme 6 Implementation Project for the Fitzroy Basin (Coakes, Fenton & Lockie, 1999), where appraisal included the attitudes of farmers and land mangers to those farm and land management agencies and other institutions advocating sustainability practices and policy initiatives.

Finally, the concept of sustainability should also be represented as an `emerging' social norm. The diffusion of new social norms and their acceptance throughout society are not always immediate and are often only gradually integrated into society as '*norm*al' and accepted practices and beliefs. Social institutions certainly play an active role, as discussed later in this report, in diffusing new practices and beliefs throughout society.

2.4. DEFINING CAPACITY AND MOTIVATION

The core objective within the context of the current research project is to "identify and develop a theoretical and conceptual framework for considering *capacity* to change towards sustainable land and water management practices". However, the term capacity is not one that is commonplace in the social science research literature. A dictionary definition of capacity refers to capacity as related to 'ability', including the "power, ability or possibility of doing something…the ability to perform" (Macquarie Dictionary, 1992). Without stating the obvious, capacity itself is not a variable or indicator but represents a number of components which may be reasonably judged as affecting a farmer or land manager's ability to adopt sustainable land management practices. As one example, the level of farm profitability may reflect the farmer's ability to adopt sustainable practices, with low levels of farm profitability leaving the farmer with little or no ability to fund sustainable land management practices.

While farm financial characteristics can be identified reasonably well within the context of capacity, other broader social-psychological and sociological characteristics play a significant role in the ability of the farmer and land manger to adopt sustainable land management practices. For instance, if many farmers or land managers within a farming community have adopted specific sustainable practices there may be considerable pressure amongst those farmers who have not adopted these practices to conform to the normative actions and behaviour of the group. In this context it is not so much a question of capacity, but more a question of motivation, and in this case the motivation to conform to group norms. Similarly, the concept of an `incentive' or `drivers' of change, which are often identified and discussed outside of sociology and psychology, can generally be recognised as a component of motivation.

It is clearly important to recognise the distinction between capacity or ability and motivation when attempting to explain the adoption of sustainable land management practices by farmers. In many instances farmers may have

significant capacity to adopt sustainable practices, but on the other hand no motivation to do so. Conversely, there maybe significant motivation amongst farmers for the adoption of sustainable practices, but they may have little or no capacity to implement these practices.

While the social-psychological literature presents a number of theoretical and conceptual approaches to motivation, there are few motivational theories which attempt to integrate components of motivation and capacity or ability. One such approach, which has been applied extensively in organisational psychology, is known as the Valence-Instrumentality-Expectancy (VIE) Theory (Vroom, 1964; Porter & Lawler, 1968).

VIE theory specifies that motivation is the result of three different types of beliefs that people have, namely expectancy, instrumentality and valence beliefs and that an individual's abilities (or capacity) mediates the relationship between motivation and behavioural outcomes. Figure 2.1 summaries the general VIE model, showing the relationship between motivation, abilities (capacity) and behavioural outcome. Of most importance to this project is that the VIE model emphasises that abilities, or what have been generally defined as capacities in the present context, are *a necessary but not sufficient condition for behaviour change.*

The motivational components in this particular model take into account expectancy, instrumentality and valence. As an example drawn from the current research context, **expectancy** may represent the extent to which changes in farmer behaviour or farm practices are likely to meet the expected goals of sustainability. **Instrumentality**, on the other hand, may represent the rewards the farmer believes may be obtained from changing farm management practices towards the goals of sustainability. If the on-farm change that is required is believed to be costly and of little immediate financial value to the farmer, it is unlikely that farmers would be motivated to implement change. Finally **valence** represents the extent to which the farmer values the benefits and rewards of adopting sustainable practices. For example, if the farm is unlikely to be transferred to other family members, the maintenance of a sustainable farming system maybe viewed as having little value to the farmer.

Although the VIE model maybe usefully applied to better understanding the adoption of sustainable management practices amongst farmers, the value of the model in the present context is to enable a clear distinction to be drawn between the motivational and capacity characteristics which underpin behaviour change.

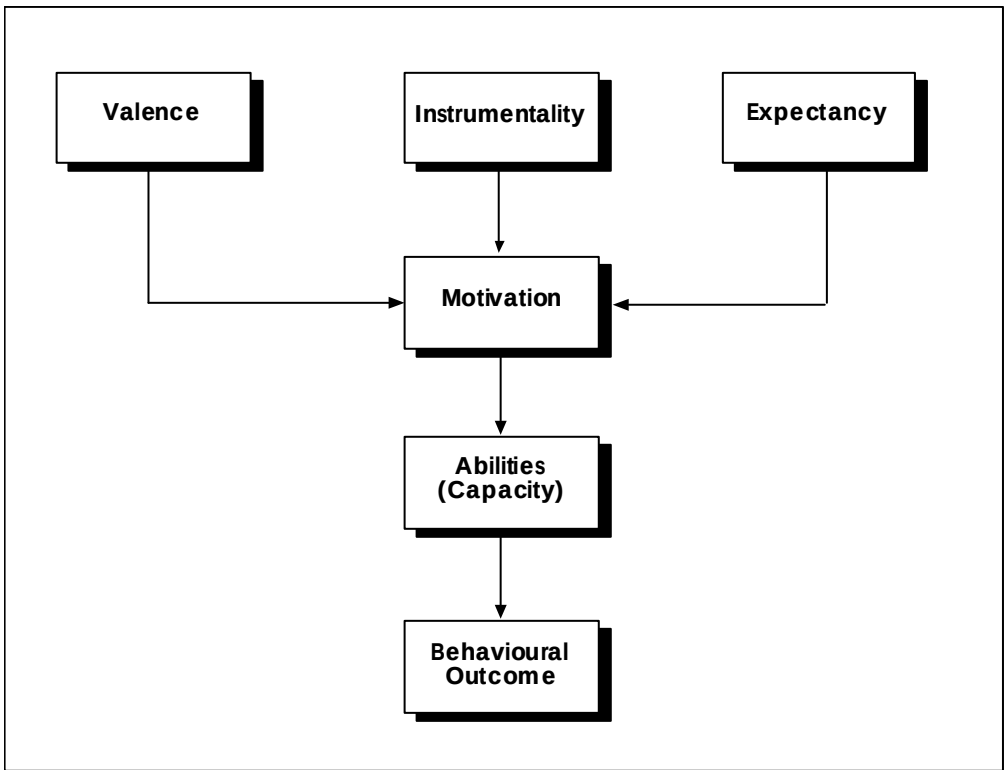

Figure 2.1. Overview of the Valence-Instrumentality-Expectancy Theory

2.5. ADOPTION AND DIFFUSION RESEARCH

While objectives 1 and 2 of this research project required the project to draw upon the initial research developed in the Theme 6 Fitzroy Basin Demonstration Project, it was also considered important to provide a more detailed review of the literature and research on the adoption and diffusion of agricultural innovations and new farming practices. This research area has a long history, dating back to the 1940's and 1950's when the construct of interest was the adoption of new agricultural innovations associated with new varieties of corn (i.e., Ryan & Gross, 1943) and soil conservation practices (i.e., Lionberger, 1952)

In a recent review of the adoption literature and factors influencing adoption for the Bureau of Rural Science's Social Sciences Centre, Barr (1999) has suggested that adoption research had two fundamental objectives. One of the aims of the adoption research was to study the characteristics of specific innovations that affected the rate of adoption. The second aim was the study of the "characteristics of farmers which lead to their being enthusiastic or less than enthusiastic adopters of innovations" (p.2). In relation to the second research aim, there has been a number of studies which have focused on the adoption decision making process.

One of the most extensive treatments of the adoption process was that developed by Rogers and Shoemaker (1971). Their model conceptualised the adoption process as comprising three major divisions: antecedents, the

adoption process and consequences. Antecedents comprised specific characteristics of the individual, which influenced adoption, including for instance the individual's social and demographic characteristics and the perceived need for the innovation. Importantly for the present study, and given the previous discussion of sustainability as an emerging social norm, is that antecedents also included relevant behavioural norms, the level of acceptable tolerance or deviation from these norms and the amount and type of informal communication occurring in relation to the innovation.

In relation to the adoption process itself, Rogers and Shoemaker (1971) conceptualised the adoption process as having four stages which included (1) initial knowledge of the innovation, (2) persuasion towards the innovation, (3) the decision of whether or not to adopt the innovation and (4) confirmation sought after the decision had been made.

The importance of the Rogers and Shoemaker (1971) model of the adoption process is that it clearly recognises what we have conceptualised as motivations and capacities at the individual level and the importance of these factors in the adoption process. In addition, the model of adoption also recognises the importance of social norms and the extent to which farmers, given their level of tolerance for any deviation from these norms, will attempt to conform to the prevailing social norms. Given that sustainability has been conceptualised as an emerging social norm, the prevalence of this norm in farming communities will, it is suggested `drive' or motivate farmers to engage in behavior or change their behaviour which is congruent with this social norm.

The role of social norms and the change agents and institutions as carriers and diffusers of normative behavioural practices has long been recognised in the adoption-diffusion research, and is found in Roger's (1962) seminal treatment on the diffusion of innovations. In the early 1960's, Katz (1961) also emphasised the broader social and contextual basis which underpinned the adoption and diffusion of innovations by stating, "It is about as unthinkable to study diffusion without some knowledge of the social structures in which potential adopters are located as it is to study blood circulation without adequate knowledge of the structure of veins and arteries" (p. 72)

Studies of the adoption process have also sought to identify 'adopter categories' representing the classification of individuals on the basis of the their level of innovativeness. Rogers (1962), using a system of classification frequently cited in the adoption-diffusion literature characterises individuals as (a) innovators, (b) early adopters, (c) early majority adopters, (d) late majority adopters and (e) laggards. Early research attempting to develop social profiles of these adopter categories found that early adopters in comparison to later adopters

- were younger,
- had a higher social status,
- had higher wealth and financial income,
- were reliant on formal rather than informal informational sources about the innovation,
- obtained information from outside the local community or region, and
- utilised a greater number of information sources.

Laggards are of particular interest as an adopter category as they represent that group of individuals who are reluctant to adopt new practices and innovations. Toyne (1974) has suggested five reasons why laggards maybe reluctant to adopt new practices.

1. they may be simply lazy or slow;
2. they may perceive that the innovation is not in their best interests;
3. they may be older people and so reluctant to change;
4. they may be, in some way, constrained in their behaviour eg they lack sufficient finance
5. they may believe there are better alternatives to the innovation that is being presented and so they do not wish to restrict their possible future options by adopting.

What is interesting in relation to Toyne's (1974) reasons for non-adoption is that they present a mixture of what maybe considered motivational and capacity characteristics. The perception that the innovation is not in their best interests or that there maybe better alternatives to adoption are clearly motivational components as represented by expectancy, instrumentality and valence. On the other hand, age and financial 'constraints' could generally be considered as components of capacity or ability.

The diffusion of innovations or new practices is particularly important given the previous discussion in relation to the concept and practice of sustainability as an emergent social norm and the `diffusion' of this norm throughout the community. The diffusion process represents the way in which new technologies, practices or innovations are communicated from one individual to another and the process through which it spreads throughout the community. The rate and extent of diffusion "depends on the nature of the technology; the numbers and types of communication channels and linkages among members of the population; the values, norms and attitudes prevalent in the community; and the institutional support for using the new technology" (Korsching & Hoban, 1990, p. 2)

The diffusion research suggests there are two ways in which an innovation or new practice will diffuse, namely contagious diffusion and hierarchical diffusion. Hierarchical diffusion has its origin at the 'top' of the social structure with information and practices diffusing down the social structure from top to bottom. For example, governments can often be identified with this 'top-down' process. They effectively may become the initial innovators promoting the adoption of an innovation. The hierarchical nature of the process means that the innovation works its way down through government agencies and departments and out to the extension and field officers who then diffuse the innovation to farmer groups, associations, cooperatives and individual farmers and land managers.

The concept of sustainability, discussed in Section 2.1, follows this hierarchical top-down diffusion process, with the concept itself being initiated through inter-governmental agreements (i.e., WCED) and diffusing through Commonwealth and State governments to environmental and community groups at a local level such as for example, Landcare, Bushcare and other community based groups.

Comparatively recent research within the diffusion paradigm suggests the role of information in the evaluation or adoption of sustainable land management practices to be particularly important. Information in terms of its declining order of importance to farmers has generally included, (1) other farmers who have already adopted new practices or technologies, (2) local agricultural dealers that sell or support the technology and (3) government agencies that provide agricultural information, technical assistance and financial support to farmers (Korsching & Hoban, 1990).

The role of economic influences in the adoption of innovations was recognised more in the late 1970s by writers such as Pampel and van Es (1977) and Taylor and Miller (1978). These writers noted that the underlying assumptions associated with of adoption of innovations must also include an economic dimension – because economic circumstances may constrain the adoption process. This is particularly relevant to the adoption of sustainable land management practices, which may be perceived as having very little immediate economic benefit. Pannell (1998) notes that even for innovations orientated towards resource conservation, economic considerations are the most important determinants of actual adoption decisions. For example, Cary and Wilkinson (1997) found that the best way to ensure that sustainable land management practices are adopted is to ensure they are economically profitable. Studies that have recognised economic or financial issues in the adoption process have addressed this issue through the inclusion of such variables as farm income, farm profitability, farm equity and farm capital as predictors of adoption practices.

Studies in the 1980s and 1990s in the United States by writers such as Nowak (1987), Carlson & Dillman (1988); Makowski, Sofranko, & van Es (1990); Thomas, Ladewig,. & McIntosh (1990); Saltiel, Bauder, & Palakovich (1994) and Turrell & McGuffog (1997), have attempted to acknowledge both the economic and socio-demographic perspectives and treat them equally when undertaking adoption research. In particular, Nowak (1987) has stressed the need to include an economic and diffusion or social perspective in research, and states:

> *"…the decision processes surrounding the adoption of conservation technologies have a strong economic dimension. Yet what farmers should do according to economic theory is not the same as what farmers actually do in adopting a new technology. Therefore, instead of stopping with the legitimate deduction that economics is important in the adoption of conservation practices, we must go on to the equally important task of explaining the variability among farmers in terms of their pursuing conservation objectives. That explanation needs to be based on diffusion [social] as well as economic considerations" (p. 218)*

Research undertaken within the adoption-diffusion paradigm represents the most significant source of information in relation to the development of a conceptual framework and the selection of appropriate indicators within this framework. It is clear from a review of this research that the framework that is developed must take into account specific socio-demographic characteristics of farmers and land managers (Rogers and Shoemaker, 1971) and that it should equally recognise the broader social conditions and context in which adoption occurs. In relation to this latter point, this includes the prevalence of social institutions and activity of social institutions that diffuse normative behavioural standards in relation to sustainability throughout the community. In addition, as evident in some of the more recent research within the adoption-diffusion paradigm the framework should also include economic and farm financial characteristics and attempt to develop indicators in relation to the diffusion of sustainability information.

2.6. A CONCEPTUAL FRAMEWORK FOR CAPACITY TO CHANGE

Studies within the adoption-diffusion paradigm have examined a broad range of variables and indicators in relation to adoption. These include economic, demographic, technological and informational indicators, all of which maybe worthy of inclusion as indicators of the capacity to change towards more sustainable land and water management practices. There is a danger however, that without careful examination, an outcome of this project could simply be an endless list of potential indicators derived from the literature and through heuristic decision making processes.

In addition, it is not so much a matter of identifying all potential indicators, but of identifying those indicators that are likely to explain a significant component of the variation in farmer and land manager change to more sustainable land management practices. Indicators which are likely to explain two or three percent of the variation in change towards sustainable land management practices, while they may be of interest, should not on a practical and pragmatic level be given the same weight as indicators which have been shown to explain a significant percentage of the variability in change behaviour. Without primary research as part of this project, and relying solely on previous research in this and related areas, it appears clear that those indicators which have consistently and repeatedly been shown to have some predictive capacity, either theoretically or empirically, should be included in the development of any framework.

Force and Machlis (1997) in the selection of social indicators for ecosystem management use specific criteria for indicator selection and it is these criteria which have also been adopted in the present study when identifying specific indicators. The criteria used in selecting indicators include, "(a) an extensive review of the literature, (b) relevance to ecosystem management activities, (c) ease of understanding and interpretation by resource managers, (d) availability at the national level and (e) accessible good quality data" (Force & Machils, 1997).

A review of the literature in this area focussing specifically on variables or concepts that have been identified in previous research as potential predictors of change towards sustainable or new management practices is presented in summary form in Table 2.1. While this table is certainly not exhaustive in identifying all possible variables or constructs, it nevertheless becomes quickly apparent that there is some commonality amongst researchers as to what the more salient indicators maybe. It is argued that the common variables and concepts identified in Table 2.1, given their repeated discussion in previous research would be the most likely and reliable variables and concepts to be used when predicting changes in farmer behaviour towards sustainable land management. While there most certainly are additional variables that have not been identified in Table 2.1, it is probable that these additional variables account for significantly less of the variability in predicting farmer change behaviour when compared to those variables that have been identified.

The predictor variables identified in Table 2.1 have also been classified under a number of broad headings, which are not always exclusive but which nevertheless provide some structure to the type of variables that are considered particularly important as predictors of change. The structure and type of variables identified in Table 2.1 raises five important points.

Firstly, the variables themselves are not exclusively social or financial (economic). In an applied and pragmatic sense, predicting change in farmer behavior will need to reflect variables and concepts from both disciplinary domains. To retain a purely disciplinary focus, either social or economic, will exclude many significant and important predictor variables.

Secondly, the indicators identified in Table 2.1 are drawn from numerous studies, which predominantly use survey research and which at the same time attempt to predict the adoption of many different sustainable land management practices. For example, an indication of the type of practices that have been investigated include, crop rotation (Saltiel et al. 1994), soil erosion (Hefferman & Green, 1986), conservation tillage (Nowak, 1987), rinsing of empty chemical containers (Turrell & McGuffog, 1997) and the adoption of hybrid seed corn (Ryan & Gross, 1943). The variation in the type of adoption practices being investigated, may it is argued, explain some of the divergent and sometimes contradictory findings evident in the adoption research.

Thirdly, and given the earlier discussion on the motivational and capacity components of change, the variables identified in Table 2.1 are variables that could be regarded as relating to both motivation and capacity. While it may in the first instance be a useful exercise to distinguish motivational and capacity variables in order to elaborate a clearer theoretical basis for farmer change and adoption, this is somewhat problematic as any one predictor variable in a specific context may act as both a motivator of change and in providing the capacity for change. Although a specific variable may play a role in predicting capacity to change, in so far as it accounts for a significant percentage of the variability in change behaviour, the nature of the causal relation between the variable and behaviour change is very much dependent upon broader individual and contextual issues.

For example, and using what would otherwise appear as a relatively straightforward variable of farmer age, the age of the farmer may act as either a motivator for change and/or as a reflection of the capacity of the farmer to change. As a motivator for change many older farmers may see less instrumental benefit in changing to new farming practices when compared to younger farmers (ie. VIE motivational model presented in Figure 1). On the other hand, older farmers may have less capacity to change, in so far as existing farming traditions and styles maybe very much embedded in their farming practices leaving little flexibility for the adoption of new farming practices.

Fourthly, while the majority of variables identified in Table 2.1 are generally scalable, in terms of an interval or ordinal series, the direction of the relationship between the variable and behaviour change may not always be consistent. The importance of farm size, is one example of competing explanations for the direction of the relationship between a specific predictor variable and change behaviour. For instance, research by Buttel, Larson, & Gillespie (1981) found that small-scale farmers were most likely to adopt soil conservation practices, while research by Earle, Rose & Brownlea (1979) found significant and contradictory findings to that of Buttel et al (1981), where large scale farmers were most likely to adopt conservation practices. The most prevalent hypothesis in relation to small-scale farmers is "that small-scale farmers preserve the environment better than large-scale farmers because the capital-intensive technologies large-scale farmers use force them to take a short-term view of their farming operation" (Hefferman & Green, 1986, p. 35). In contrast, a prevalent although contradictory view, is that small-scale farmers are less likely to preserve the soil than large scale-farmers because of economic constraints or that, and particularly in an Australian rangelands context, high stocking rates and small property sizes are related, often leading to over-use of resources and associated land degradation (Passmore & Brown, 1991; Beal, 1997).

Finally, many of the variables are not necessarily independent and there may well be some level of covariation or relationship amongst specific variables when used to predict behaviour change. For example, there may well be high levels of covariation between the age of the farmer, years of farm management experience and family size.

The latter two points, concerning the direction of the relationship and the possible covariation amongst predictor variables, are clearly not able to be resolved through a review of the literature. However, they do strongly suggest the need for pilot research to be undertaken using the proposed conceptual framework and methodology prior to embarking on large-scale secondary data collection and research. Embarking on a large-scale research program without initial ground-truthing or pilot research and given many of the contradictory research findings in previous research might lead to a significant danger of misunderstanding the direction of the relationship between predictor variables and behaviour change.

The concepts and variables identified in Table 2.1 represent the most important concepts and variables that have been identified from a review of the previous literature. There are a number of issues raised in relation to these variables -

both at a theoretical and methodological level. Nevertheless, they nevertheless represent a range of substantive concepts that should be included in any framework which attempts to identify predictors of change towards sustainable land and water management amongst farmers and land managers.

The concepts identified in Table 2.1 provide a useful starting point for the development of a theoretical framework. Provided due recognition is given to the questions of motivation and capacity and the recognition of sustainability as an emerging social norm, it is possible to recast these concepts into a broad framework. This framework will allow the delivery of a pragmatic indicator development program able to address the objectives of the Audit.

Table 2.1: Summary of Indicator Types

Indicator Type	Number of Citations
Education and Training	
Level of farmer education & training	15
Level of farmer participation in management relevant training	8
Farming or Land Management Experience	
Age of farmer	16
Years of farm management experience	8
Length of residence	5
Farm Financial Characteristics	
Level of farm income	15
Level of farm debt	5
Level of farm business profit	5
Level of off-farm income	4
Farm Family Characteristics	
Family members working on-farm	4
Number of children (family size)	2
Farm Structure	
Farm size	16
Ownership of farming property (tenure)	13
Enterprise mix (type of farm)	12
Labour management (use of labour)	5
Level of off-farm employment	5
Attitudes, Perceptions Towards and Expectancies of Change	
Awareness of on-farm land degradation issues	8
Perceived utility (relevance or need) of proposed change	5
Attitudes towards change and change goals	2
Attitudes towards change agents and information	2
Social and Institutional Contact as Sources of Change	
Contact with Landcare and similar groups	10
Contact with government agencies and staff	8
Information from media sources (trade magazines, TV, radio etc)	5
Contact with agricultural suppliers and agents	3
Diversity of information sources	2
Access to and use of WWW	2
Past and present relationship with extension personnel	2
Voluntary Participation	
Level of industry and group participation and involvement	6
Time spent in land management group participation	5

Note: *Table 2.1 includes only those indicators that have been cited in two or more independentresearch papers as possible predictors of adoption or change towards sustainable landmanagement practices. In some cases the indicators have been tested empirically, while in others the indicator has been identified as part of a broader attempt to conceptually understand the underlying predictors of change.*
The use of the term farmer also includes landholder and land manager.
Citations are drawn from both Australian and International studies and research papers.

Source: *BRS (1999).*

On the one hand, Table 2.1 suggests there are a number of concepts related to both motivation and capacity, which are operating at the individual farmer or land manager level. These include, for instance, the financial characteristics of farms, the individual characteristics of farmers and their families and the structure and type of the farming enterprise. This group of concepts may, in specific contexts and under specific circumstances, act as either motivators and/or as reflective of the capacity of farmers to adopt sustainable land management practices.

In addition, Table 2.1 also suggests the importance of broader community and institutional change agents, which interface with farmers and land managers in providing information about farm practices and outcomes which may lead to better and more sustainable land management practices. What is important here is that the existence of change agents in the farming community including farm extension and advisory personnel, agencies and groups, Landcare groups, farm planning and training groups and organisations and broader environmental and planning programs within a community, will often act to facilitate change towards sustainable land management practices. These organisations will often act to *diffuse* emerging normative farming practices, including those related directly to sustainability, into the local farming community. Farming communities in which a number of these change agents are operating, or in which such change agents are very active, will be more likely to implement or adopt sustainable land management practices when compared to those communities in which there are very few change agents or where these change agents are less active.

That farmers may have the motivation or capacity to implement change or that change agents exist within the farming community is not in itself a sufficient condition for change to occur. As Barr (1999) and Vanclay and Cary (1989) have pointed out in the Australian context, it is important that the degradation is seen, perceived, recognised or identified by the farmer or landholder. Barr (1999), in a discussion of 'seeing land degradation', provides a number of highly instructive examples, which illustrate that without the recognition of land degradation, farmers may have all the motivation or capacity required, but it will be of little use if land degradation is not recognised in the first instance. The importance of `seeing' land degradation, is certainly not a new concept and was recognised in early studies of the adoption process in the late 1950's and early 1960's (i.e., Hassinger, 1959; Rogers, 1962).

For the purpose of this study there is considerable difficulty, without primary data collection, in identifying those specific variables, which contribute to farmer recognition of land degradation. However, this issue is of such critical importance that a conceptual explanation has been proposed which may enable specific variables to be identified and which goes some way to providing indicators of the likelihood of land degradation being recognised.

We have argued that the existence of change agents within farming communities is one of the conditions likely to increase the probability associated with the adoption of sustainable practices. It is also likely that the greater the level of farmer involvement and participation with such agencies and organisations, the more likely the informational and educational functions of these organisations are to lead to greater awareness and recognition of land degradation amongst the farming community. As such the level of farmer participation, in terms of time spent in participation or the length of active involvement with such organisations, maybe useful although not direct indicators of the likelihood of recognising land degradation problems. In addition, it is also probable that the level of farmer education and general farm management training may play a significant role in the appraisal of land degradation.

In summary, the previous discussion suggests that a framework for the identification and use of specific indicators should include three components. They include:

1. **Individual Indicators**
   Including motivational and capacity indicators at the farm and individual farmer level.
2. **Institutional Indicators**
   Including the prevalence, number and level of activity of change agents in the farming community
3. **Appraisal Indicators**
   Including the level of farmer and land manager participation in farm and land management organisations and groups and additionally levels of farmer education and training

While the three components within this framework draw on both the adoption and diffusion research, the institutional and appraisal indicators also address some of the more recent debates in relation to the importance of social capital. While it is not intended to provide a detailed discussion of the appropriateness of the concept of social capital (see Wall, Ferrazzi & Schryer, 1998), many of the issues embedded in the concept of social capital underpin the rationale for selecting institutional and appraisal indicators.

Putnam (1993) for instance considers social capital as an aspect of social organisation that includes trust, norms and networks, which together enhance cooperative actions towards specific goals. The prevalence of farm and environmental institutions in the community, and the degree to which there is cooperative action, participation and involvement in these social institutions in moving towards the social norms and goals of sustainability provides some indication of the level of social capital that may exist in the community. It is also argued that the prevalence of social institutions within a community that diffuse and direct community action towards the emerging social norms and goals of sustainability also constitutes an important component of social capital.

It is important to recognise that the framework has been developed with some forethought as to the aims and objectives of this specific Audit project and the anticipated methods and applications to which any framework maybe applied. The framework has been developed which may,

(a) be generally applicable to a number of farming types,
(b) is able to be applied at a regional and sub-regional level,
(c) relies primarily on secondary data sources,
(d) is parsimonious in terms of its general application and use, and
(e) provides important information for policy development.

Many of these issues will be discussed later in greater detail. However, at this juncture it is also important to emphasise that, while the framework has been developed for use with secondary data, it is also readily applicable as a framework that maybe used in the collection of primary data and in particular the use of survey research.

The three component framework is identified schematically in Figure 2.2 In this example the three components of the model are shown on a priori and theoretical grounds as orthogonal to each other. The individual points within the three dimensional space could well represent individual farms, specific geographic regions or sub regions or different farm types (i.e., dairy, beef, wool, wheat etc). This is a particularly important outcome for this model, in that it allows wide generalisability of the framework when working with different units of analysis.

Using descriptions for each of the three components in the model, Figure 2.3 provides an example of how, if using areas as the unit of analysis, these specific areas maybe described and differentiated on the basis of the underlying indicators. In this example, Area G is identified as an area with high farm income and low debt (individual), a low number of farm support organisations (institutional) and an area with limited potential recognition of land degradation issues (appraisal). In contrast Area C has low farm income and high debt (individual), a moderate number of farm support organisations (institutional) and potential for high recognition and awareness of land degradation issues (appraisal).

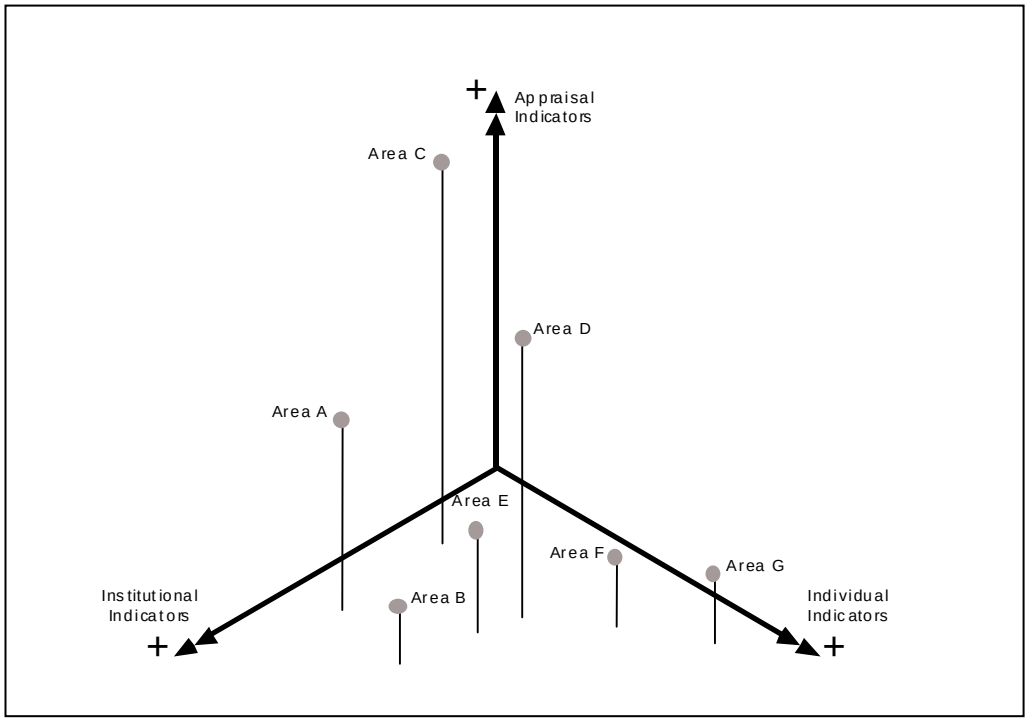

Figure 2.2 Three Component Model of Sustainability Indicators

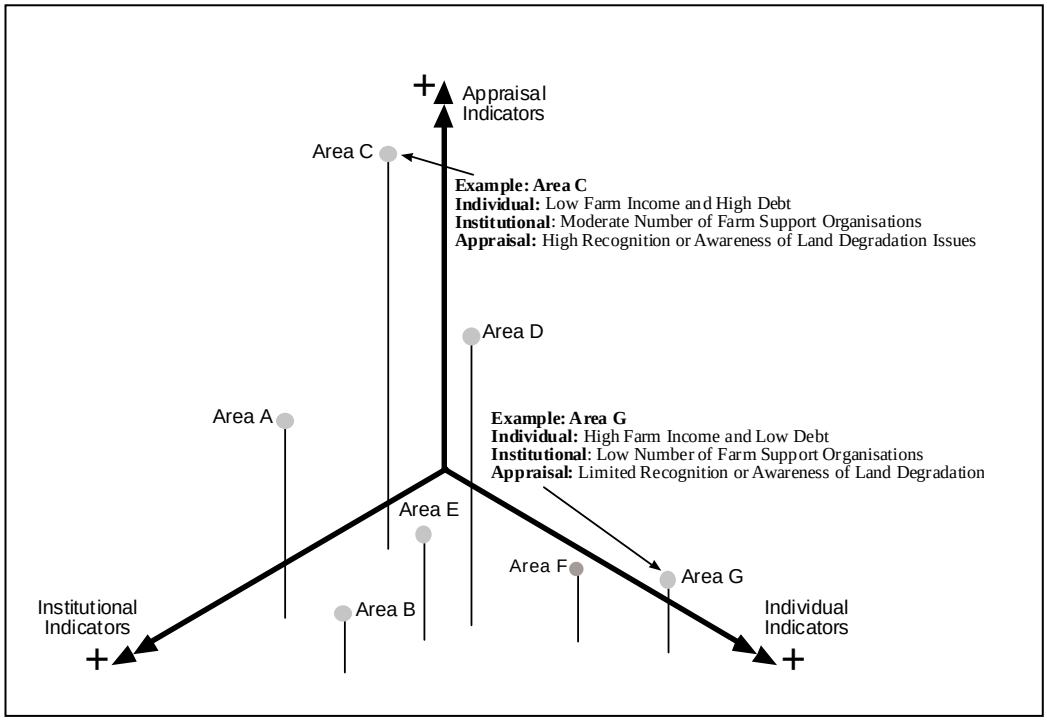

Figure 2.3. An Example of the Application of the Three Component Model

Several additional and important issues in relation to the use and application of the three component framework are also shown in Figure 2.4.

The first issue concerns the identification of those areas where the likelihood of adoption of sustainable land management practices is low. Clearly those areas which generally fall within the lower corner of the cube and which are low on all three components would certainly have a very low likelihood associated with the adoption of sustainable land management practices (Figure 2.4A). However, it is also possible that if an area is low on any one of the three components the area would be significantly less likely to adopt sustainable practices than an area which is high on all three components.

Secondly, in the example shown in Figures 2.2 and 2.3, the unit of analysis has been based on areas, however, there is no reason why additional farm, economic or biophysical information cannot be used in interpreting the distribution of areas in relation to the three components. For instance, and as a simple example, it may well be that Areas A, B and E represent significant dairy farming areas (Figure 2.4B) or that areas G and F (Figure 2.4D) are areas where salinity has been a significant land degradation issue for a number of years. Similarly Figure 2.4C shows how different agricultural sectors, based on the aggregation of specific geographic areas, may be used in the framework.

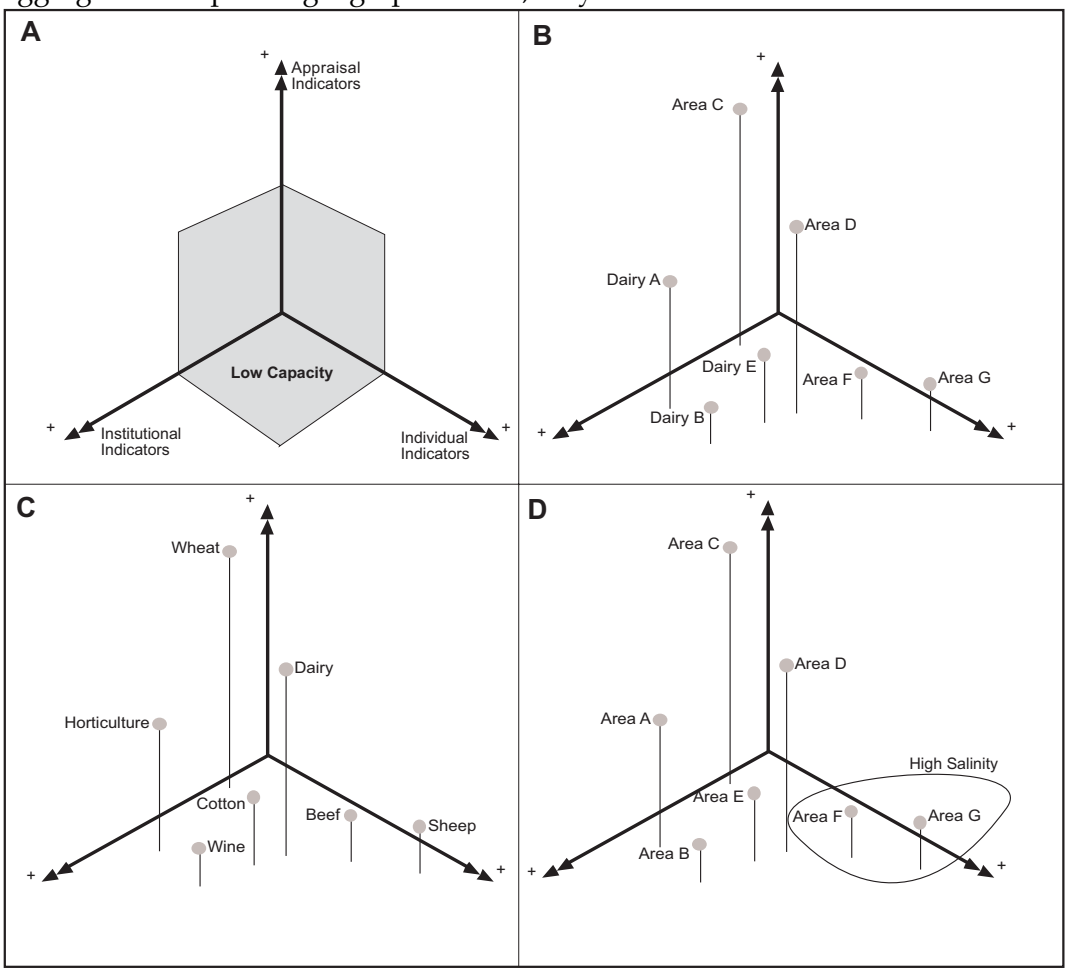

Figure 2.4. Examples of the Application of the 3 Component Model

The framework may be generalised to very different contexts using different units of analysis and employing different research methodologies, including survey research or secondary indicators research. The framework is also significant in relation to its application to other Audit themes, which may also be examining capacity to change. In particular the framework provides a basis for Audit Project 6.1.2, which is examining capacity to change amongst broadacre farmers, Project 6.3.1 which focuses on capacity to change within the dairy industry and Project 6.3.3, which is examining change in the context of dryland salinity and watertable control.

2.7. PREDICTIVE MODELLING

The three component framework that has been proposed is primarily a descriptive one in so far as the direction, strength and inter-relationships amongst specific indicators have not been explicitly described. Any attempt to derive a complete predictive model which encompasses all possible environmental, behavioural, social and economic indicators and which identifies the inter-relationships amongst these variables would be an impossible task given the current state of knowledge and research in this area. Furthermore, the development and application of a predictive model at a national scale, which is meaningful in relation to all farming practices, would require extensive survey based data collection and be of such complexity that very large data sets would be required in order to empirically test such a model.

The difficulty and complexity of defining a priori predictive models of adoption is highlighted in Figure 2.5. In Figure 2.5 no attempt has been made to identify specific indicators within each of the three components. The characteristics of locality and environment have been included, as have the characteristics of specific adoption practices. In addition, this model also shows that there would be a number of adoption practices that could be identified as contributing towards sustainable land management.

Figure 2.5 is simplistic, in the sense that indicators have been grouped into components rather than identified individually. However, the complex causal relationships that are possible amongst components within even this simple model, emphasises that the development, data collection and testing of an all-inclusive a priori causal model at a national scale would be of such complexity that the time and resources required in its development and testing would be prohibitive to the Audit.

The following discussion further highlights the complexity and difficulty of developing a priori predictive models of adoption.

Central to the model presented in Figure 2.5 is the appraisal component which represents farmer and land manager beliefs about and attitudes towards natural resource management, land degradation and specific adoption practices. As shown in Figure 2.5, appraisal also includes farmer and land manager attitudes towards those organisations and institutions that are

'promoting' sustainable land management and, as identified previously, the recognition and identification of land degradation. Feedback loops are also shown in Figure 2.5, where not only do appraisal and other indicators, determine the adoption of sustainable practices, but the adoption of practices in the past may have changed how the farmers view (appraise) the adoption of other practices in the future.

Differences in appraisal are determined by a range of individual, institutional and contextual variables and complex interactions amongst these variables. For example, negative attitudes towards the land, as in the belief that the land is "rubbish country", is a component of appraisal which includes beliefs about land and land management which may act as a barrier to the adoption of sustainable land management practices. The existence of this belief may be due to specific individual characteristics, historical relationships between the farmer and those agencies promoting sustainable land management and specific environmental and locality characteristics in which farming occurs. To date there is limited understanding or research on the appraisal component and its relationship to the adoption of sustainable land management practices and there are certainly no existing 'indicators' of appraisal. It is probably the case that many of the existing individual indicators that have been used in previous research are themselves being used as surrogates for appraisal. For instance, when the age of the farmer is used as a predictor of adoption, it is not the chronological age of the farmer that is important, but in many instances the beliefs and attitudes (appraisal) that accompanies differences in age.

Figure 2.5 also emphasises that adoption of sustainable NRM practices is not uni-dimensional and that it consists of a wide range of practices that are dependent upon environmental, institutional, individual and appraisal characteristics and their interactions. Again, there is limited understanding and research on adoption practices, including how they are defined or classified or whether for instance it is useful to distinguish between intention to adopt and actual adoption.

The complexity of developing an *a priori* predictive model such as that shown in Figure 2.5, and the limited existing data or previous research which may address components and their interactions within the model, suggest that preliminary survey research should be undertaken in order to identify important predictors of adoption. Survey research would include specific individual, institutional and appraisal indicators identified in Section 4 and an assessment of a range of adoption practices across several different geographic localities.

On the basis of survey research, structural equation modelling could be used to identify and explore the causal relationships and paths in predicting the adoption of sustainable land management practices, which would provide some indication of the direction, strength and interactions amongst variables and indicators in the prediction of adoption. This approach is a mix of inductive and deductive approaches to the development of an explanatory model, where we specify the indicators to be collected in survey research but with speculated causal relationships and interactions (implicit in the structural equations). The

power of a given model in explaining adoption then can be identified on the basis of an analysis of survey data.

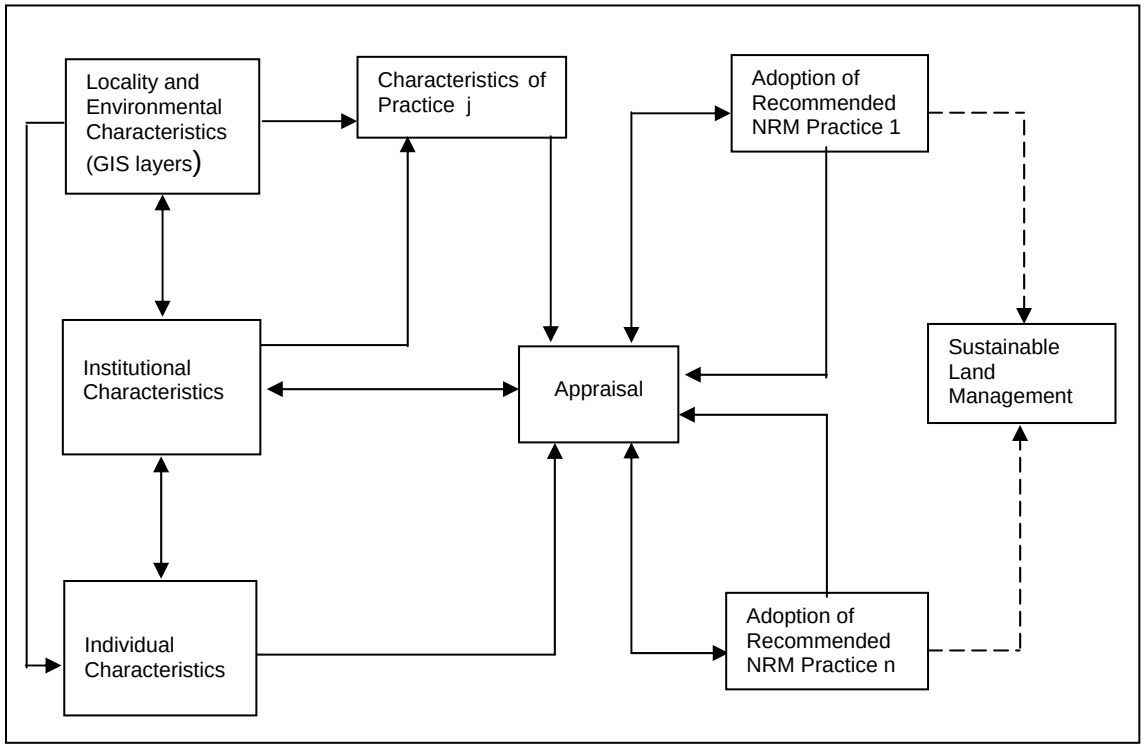

Figure 2.5. An Example of a Predictive Model of Adoption of Sustainable Land Management Practices

3. THE SELECTION OF INDICATORS

Prior to any discussion in relation to the identification of possible indicators it is useful to distinguish amongst several terms which are often used interchangeably in the research literature and in discussions related to the measurement of sustainability in social research. Terminology in this area commonly focuses on the use of the terms variables, constructs, indicators, proxy indicators and composite indicators.

The use of the term variable is commonplace in social psychological and sociological research and should be used to describe tangible characteristics on which individual farmers and farms differ. Examples of specific variables would include for example, the number of children in the farm family, farm size or farm type. The term construct on the other hand should be reserved for the less tangible, concrete or objective characteristics. Level of farmer expertise, trust in farm organisations and extension agencies are influence examples of constructs (Ghiselli, Campbell & Zedeck, 1981).

On the other hand, the term indicator implies an interest not in the attribute that is being directly quantified, but an interest in the variable or construct which cannot be directly measured or quantified. For instance, and with reference to this project the age of the farmer or farm debt levels are not of direct interest in their own right. What is of interest is the construct of capacity, which cannot be quantified directly and for which indicators have to be used.

Questions as to what constitutes a social indicator are often bound to the disciplinary areas in which the social indicator research is being undertaken. However, a generally accepted definition of a social indicator is given by Andrews and Withey (1976), who state that indicators:

> *"can be monitored over time…can be disaggregated to the level of the relevant social unit…The set of indicators should be 'limited' so that a substantial portion of the most salient or critical aspects of society is included. They should be 'coherent' in that it would be helpful to our understanding if they hung together in some form that would eventually lead to a model or theory about how society operates" (p.4).*

Applying the definition of social indicators presented by Andrews and Withney (1976) to the present research suggests that if indicators are to be defined they should

(a) be capable of being monitored over time,

(b) be able to be disaggregated to relevant social units,
(c) include only the most salient variables and constructs as predictors of sustainability, and
(d) be coherent in the sense of being part of an existing theory or framework or capable of leading the theory and framework development.

Clearly in the previous discussion the latter three points have been recognised and discussed, while the selection of indicators able to be monitored across time is the subject of data availability and acquisition and is discussed at a later point.

Carlisle (1972) has also discussed four main types of indicator, with the addition of a fifth type as proposed by Edwards (1975). However, the classification of indicator types, as proposed by Carlisle (1972), focuses specifically on the use or function of social indicators. These include:

- *Informative indicators* - indicators used to describe the social system and the changes taking place e.g. social statistics subject to regular production as a time-series and which can be disaggregated by relevant variables
- *Predictive indicators* - these indicators are informative indicators which fit into explicit formal models of subsystems of the social system e.g. indicators such as family income and urban recreational facility location may be used in a model attempting to predict potential levels of juvenile crime in a neighbourhood
- *Problem-oriented indicators* - these are indicators which point particularly toward policy situations and actions on specific social problems
- *Program evaluation indicators* - indicators used to monitor the progress and effectiveness of particular policies, and
- *Target delineation indicators* – variables describing demographic, environmental, pathological or service provision characteristics, which are useful in identifying geographical areas or population subgroups toward which policy is directed.

The three component framework discussed in Section 2.6, appears to address all five functions identified by Carlisle (1972). The framework is certainly informative in so far as it provides a description of capacity and motivational issues in regard to the adoption of sustainable land and water management practices. The framework is also clearly predictive in the sense that it attempts to predict variation in the adoption or on adoption of sustainable practices. As discussed in greater detail later, the framework consists of indicators that are problem orientated, in so far as knowing how regions or farm types vary on the three components will provide clear direction for the development of specific policies. Although the framework and associated indicators have not been developed explicitly for the purpose of program evaluation it nevertheless could easily be employed to evaluate and monitor the delivery of specific programs across time. Finally, using the three component framework would

enable targeting of specific geographic areas, farm types and farming regions on the basis of variability on the three core components of the framework.

Traditionally, the main focus for indicator research, including indicator development, methodology and analysis is found in research within what might broadly be defined as human geography. Here much of the indicator research that has been undertaken has been based on objective, or at least quasi-objective measures, as found in large national, regional and social data sets (Smith, 1977; Badcock & Browett, 1997) and often applied to distinct spatial units of analysis. While this approach often represents a common conception of what constitutes a social indicator, there is nothing in the Andrews and Withey (1976) definition or the typology of indicators presented by Carlisle (1972) that constrains indicator research to such a disciplinary perspective.

The Standing Committee on Agriculture and Resource Management (SCARM), through the National Collaborative Project on Indicators for Sustainable Agriculture (1993), identified several criteria that should be used in the selection of indicators for sustainable agriculture. The criteria identified by SCARM include:

- The indicator must serve the needs of decision-makers
- Indicators must be applicable at the national level and capable of regional differentiation
- The use of indicators should lead to better decisions than would have been possible without them
- Indicators must satisfy valid sampling, statistical and consistency methodologies
- Unambiguous interpretation of key issues, trends and comparative status must be possible from the indicators selected

What is important in relation to the SCARM criteria is that indicators of sustainable agriculture that are selected 'must be applicable at the national level and capable of regional differentiation' and that they should allow for trend and comparative analyses to be undertaken. This clearly constrains the use of potential indicators to those that are available from large national datasets and to those indicators on which time series information is available or could potentially be available in the future.

Although the SCARM criteria are important, an additional requirement is that the selection of indicators, and in particular social indicators, should be grounded in a reasonable a priori conceptual framework. To do otherwise is to simply revert to the selection of indicators on the basis of heuristics or uninformed opinion, the previous experience of the researcher or 'what was thought important at the time'.

In order to assist in minimising measurement error it is particularly important where there are complex constructs being investigated that composite indicators are used. This means that rather than relying on a single indicator variable for a specific construct, construct validity can be improved by

aggregating several indicator variables together yielding a composite indicator for a specific construct of interest. For example, level of farm management experience may be based on the age of the farmer, education level, years farming and so on. While this is reasonably common in indicator development and measurement, it does require that each of the indicator variables have high item reliability as assessed through such indices as Cronbach's Alpha – that is, that items are highly interrelated.

The term proxy indicators is used to describe an indicator which itself is an 'indicator of an indicator' (Fenton, 1999a). Proxy indicators should be used with considerable caution as they often compound the level of error in measurement and may at times have questionable validity – that is, they may not measure what they purport to measure. They should only be used where there is an important need for indicator measurement in relation to a particular construct but for which no direct and relevant data is available.

Once indicators are derived for particular regions or spatial scales one of the most important questions that then follows is how the indicator scores are to be interpreted. There are three possible ways in which to interpret indicator scores, which include the use of thresholds and relative comparisons. Interpretation of indicator scores using absolute thresholds is uncommon and usually requires a value judgment to be made about the scale position of the threshold. Indicator scores falling above or below this threshold may then be judged as low or high or good or bad.

A more common interpretation of indicator scores is to use relative comparisons. Two forms of relative comparison that are commonly used are temporal comparisons and geographic comparisons. In the case of temporal comparisons indicator scores are interpreted relative to other time periods for which an indicator has been measured. In the case of relative geographic comparisons the indicator is interpreted relative to other regions or geographic areas. Most commonly in the case of relative geographic comparisons, indicators are compared relative to State or National averages.

It is argued that where possible, indicators should be interpreted using both temporal and geographic comparisons. Temporal comparisons clearly provide some indication of the trend in indicators across time and are important in interpreting the current value of the indicator and projecting future values. Geographic comparisons on the other hand have a particularly important application in policy developed in that they are able to identify areas or regions that are above or below state or national averages.

The following discussion provides background information and a rationale for the selection of specific indicators within the three component framework that has been discussed. It is important to recognise that indicators have been identified with a focus on providing pragmatic applications for meeting the project objectives and the goals of the Audit in relation to other Audit themes requiring the identification of specific indicators of 'capacity' to change.

3.1. INDIVIDUAL INDICATORS

The following individual level indicators have been identified, which as discussed in Section 2, may include both motivational and capacity attributes. These individual level indicators refer specifically to characteristics of farmers, farm families and the farming enterprise.

3.1.1. Farming or Land Management Experience

Age of Farmer or Land Manager

When age is considered, a greater proportion of young farmers have been found to be more aware of land degradation on their farm and to recognise the need for conservation practices to be adopted (Christensen & Norris, 1983; Seitz & Swanson, 1980). They are also more likely to be members of Landcare groups (Curtis & Van Nouhuys, 1999). Similarly a number of studies have indicated that older farmers are less likely to adopt new sustainable land management practices, as older farmers will in generally be more 'traditional' in their approaches to management and so less likely to embrace change (Bultena & Hoiberg 1983; Korsching, Stofferahn, Nowak,. & Wagener, 1983; Hefferman & Green 1986; Curtis & DeLacy, 1996, 1998; Norris & Batie 1989; Turrell & McGuffog 1997; Wilson 1997). In contrast, to the body of research which emphasises younger farmers as more likely to adopt sustainable practices, Anosike and Cougher (1990) have also suggested a contradictory explanation, where older farmers who have the necessary skills and experiences are more likely than younger farmers to adopt these practices.

Indicator Data Source

This indicator could be operationalised through Australian Bureau of Statistics census data, which would require a custom crosstabulation of the occupational classification of all employed persons within the Farmer or Farm Manger Classification (ASCO code 13 and/or sub groups) with the age of the farmer. Median scores could be derived for the required units of analysis.

The Australian Agriculture and Grazing Industries Surveys (ABARE) also provide information on the age of the farmer.

Years of Farm Management Experience

Length of experience in farm management has been found to be a significant predictor in the adoption of sustainable land management practices, however the direction of the relationship has been somewhat ambiguous. Traore, Landry & Amara (1998), for instance, has suggested that farmers may become so accustomed to seeing land degradation on their farms that they fail to see is as problematic. The more experienced farmers may recognise degradation, but given past efforts and failures to correct the problem, accept the problem as part of their continuing farming practice (Traore et al 1998). While this may be the case in some circumstances, there is also evidence supporting a contrary argument that as farm management experience increases, the more likely farmers are to adopt sustainable land management practices. For example, local knowledge is recognised as an important attribute in sustainable practices,

therefore, the longer the farmer has been working on the farm, the more sensitive they will likely be to changes in the environment. In addition, there are also several studies which suggest that the farmer's sense of 'stewardship' would also be more highly developed with increasing levels of farm management experience (Pampel & van Es 1977; Camboni & Napier 1993; Curtis & Van Nouhuys 1999).

Indicator Data Source

Information on this indicator maybe difficult to address and is unavailable from the ABS Population and Housing census and is not available in the standard annual AAGIS or ADIS surveys undertaken by ABARE. However, a supplementary survey undertaken ABARE, Attitudes and Practices in the Livestock Industry (1998) did ask the age at which the farmer or farm manager assumed financial management responsibility for their farm, which when considered in relation to the farmers age would provide an indication of the number of years of farm management experience. However this information is only available for the beef industry and was only undertaken as part of the ABARE supplementary survey in 1998.

In addition, there does not appear to be any custom tables that can be derived from these data sources, which would indicate years of farm management experience. A proxy indicator maybe to simply use the age of the farmer or to use the age of the farmer whilst subtracting the number of years not in the workforce (i.e., 15 years).

3.1.2. Level of Farmer Education and Skill Levels

Farmer Educational and Skill Levels

There is considerable evidence to suggest that the higher a farmer's educational level, the more likely the farmer is to adopt sustainable land management practices (Taylor & Miller 1978; Ervin & Ervin 1982; Hefferman & Green 1986; Carlson & Dillman 1988; Norris & Batie 1989; Thomas et al 1990; Bultena & Hoiberg 1991; Saltiel et al 1994; Turrell & McGuffog 1997; Wilson 1997; Curtis & DeLacy 1996 & 1998; Traore et al 1998; Curtis & Van Nouhuys 1999).

While the level of general education has been recognised as important indicator of the adoption of sustainable practices, the level of managerial and technical skills has also been recognised as important (SCARM, 1998). It is assumed that the better equipped the farmer is in terms of professional knowledge and skills, the greater the `capacity' the farmer has to adopt and practice sustainable management (Korsching et al 1983; Norris & Batie 1989; Witter Robotham, & Carrasco, 1996). For example, SCARM (1993) notes the importance of broad based skills such as machinery operation, computing and welding as important indicators of the ability of farmers to adopt sustainable practices, however SCARM (1998) also note that data collection for a broad-based skills index would be extremely difficult.

Indicator Data Source

SCARM (1998) in their assessment of farmer education, utilised census information drawn from the ABS population census. Custom crosstabulations

between the ASCO occupational code of 'farmers or farm managers' and highest level of educational achievement attained were used in a comparison of the 11 agro-ecological regions throughout Australia.

In addition, course of study may also be investigated through the ABS census in order to determine the relevance of that course of study to farming occupations. Relevant courses of study may include business management, agriculture and environmental science. Again custom crosstabulations with the ASCO occupational code of 'farmers or farm managers' would be required.

Additional information drawn from the ABS census may also include the age at which the farmer completed formal education, which again could be crosstabulated against the ACSO code for 'farmers or farm managers'.

Limited information is also available on education and skills from the ABARE (1998) supplementary survey on farm practices and attitudes in the beef industry which examined the whether farm workers were undertaking formal training related to the farming enterprise and the amount of time spent in formal training.

3.1.3. Farm Family Characteristics

Recent studies in the farm adoption literature have indicated that much of the adoption research has focussed predominantly "on a single male farmer making adoption decisions" (Salamon, Farnsworth, Bullock & Yusuf, 1997, p. 265) and that the characteristics of farm families are a particularly important influence on the adoption of new and sustainable farming practices. Although this maybe predominantly so, the importance of farm families in the adoption process was recognised in the late 1950's (Wilkening, 1954a, 1954b, 1956). In this context is has also been reported that sustainable farmers, more so than conventional farmers, are more likely to share farm management decisions with other family members (North West Area Foundation, 1995).

Family Members Working on Farm

Carlson & Dillman (1988) found that greater the number of family members working on the farm, the greater the likelihood that sustainable land management practices would be adopted. This may be related to the immediacy of available adult labour (Turrell & McGuffog 1997), but also, perhaps a greater level of attachment by way of stronger family associations to the farm.

Indicator Data Source

The Australian Agriculture and Grazing Industries Survey (ABARE) provides information on the number of family members working on the farm. This information is available at a SLA level, although dependent upon the number of data points within the SLA.

Number of Children (Family Size)

A study conducted by Witter et al (1996) showed that farmers who had children living with them on the farm were more likely to be using more sustainable

practices. While they do not explain why this might be the case, we may perhaps assume that, since most farms are family enterprises and that most farmers would like to hand the farm on to their children, having children is an incentive to the farmer to 'look after' the farm so that it is both profitable and environmentally 'healthy' when it is passed on. Salamon, Farnsworth, Bullock and Yusuf, (1997) also indicate that farmers identified as having adopted sustainable land management practices have larger family sizes than the more conventional farmers do.

Indicator Data Source

Custom crosstabulations from the ABS population and housing census are able to indicate family size when number of family members is crosstabulated against the household reference person whose occupation is identified as farmer or farm manager. The Australian Agriculture and Grazing Industries Survey (ABARE) also provides information on family size, however in comparison to census information there is less geographic coverage and the data only includes broadacre farming and dairy industries.

3.1.4. Farm Financial Characteristics

A long held view in much of the farmer adoption research is that that the costs of most conservation technologies exceed benefits on a short-term and possibly long-term basis (Pampel and van Es, 1977), that the farmer is expected to bear the short-term costs for some ambiguous, long-term, productivity goals and that the lack of immediate financial incentive in a dynamic farming economy results in most farmers rejecting these technologies (Nowak, 1987). In addition and as identified by Saltiel et al 1994, it is not the objective levels of profitability or cost associated with the adoption of the new sustainable practice but the perceived profitability of the adoption which influences decisions to adopt.

Beal (1997) in a review of the economic pressures affecting the depletion of natural resources on farms in Australia has indicated that since the 1950's the declining terms of trade have reduced primary producers' margins significantly on each unit of produce. Consequently, many producers "have sought to make their land produce more so that a minimum net income and standard of living may be maintained. [However it has often been the case] that degradation of the resource base has occurred, because more than sustainable use has been made of resources" (p. 213).

Level of Farm Income

Several research papers have found that the greater the level of gross farm income of the farming enterprise, the greater the likelihood that conservation and land management practices will be implemented (Pampel & van Es 1977; Bultena & Hoiberg 1983; Lynne et al 1988; Norris & Batie 1989; Thomas et al 1990; Camboni & Napier 1993; Saltiel et al 1994; Witter et al 1996).

Indicator Data Source

It is suggested that the level of farm cash income and the level of farm household income both be assessed.

The Australian Agriculture and Grazing Industries Survey (ABARE) provides information for both the level of farm cash income and farm household. This information is available at a SLA level, although dependent upon the number of data points within the SLA.

The level of farm household income is also available through custom crosstabulations in the ABS Population and Housing census.

Level of Farm Debt

Net external debt levels are not themselves directly implicated as a significant predictor of sustainable land use. What is probably more accurate is that high levels of net external debt indicate a high debt servicing burden on the farm, with the consequent need to maintain high farm incomes in order to service this debt (Daniels, 1991). It is generally considered that the higher the level of debt within the farming enterprise, the less financial flexibility there is in adopting sustainable practices (Norris & Batie 1989; Witter et al 1996). High farm debt in Australia, in particular within the rangelands context, has also been implicated in relation to increasing resource degradation (Beal, 1997; Passmore & Brown, 1991).

SCARM (1998) suggest the use of the debt-servicing ratio as an indicator of the capacity of farmers to adopt sustainable land management practices, which is the ratio of the net farm income plus interest paid to the total interest paid.

Indicator Data Source

Farm debts by loan purpose, loan type, lending source, loan term and amount outstanding is identified in the annual Australian Agriculture and Grazing Industries Survey (ABARE). The debt-servicing ratio as suggested by SCARM (1998) should also be able to be determined through an analysis of ABARE AAGIS surveys.

Level of Farm Profit

The general assumption in relation to farm profitability is that the lower the profitability of the farming enterprise, the less likely is it that the farmer will have the financial capital to invest in sustainable practices (Curtis & De Lacy 1998; Curtis & Van Nouhuys 1999). SCARM (1998) suggest the use of real net farm income or profit at full equity be used in the assessment of farm business profit.

Indicator Data Source

Farm business profit at full equity is available through the Australian Agriculture and Grazing Industries Survey (ABARE).

Level of Off-Farm Income

SCARM (1998) in an assessment of sustainable agriculture in Australia did not assess the level of off-farm income, although they have indicated that this needs to be taken into account when assessing sustainability (p. 108). The time required to work off the farm reduces the opportunities for the farmer to invest

or experiment in 'new' practices (Curtis & D'Lacy 1996 & 1998). This has been shown to be particularly the case in the Landcare context, where low participation in Landcare is often due to the farmer being simply be "too busy with other commitments" (Curtis & Van Nouhuys 1999 p. 103).

Indicator Data Source

The level of off-farm income for the farm manager and spouse, including income from wages, other businesses, investment and social welfare payments is available through the Australian Agriculture and Grazing Industries Survey (ABARE).

3.1.5. Farm Structure

Farm Size

There is considerable evidence in the literature that the larger the farm in terms of its physical size, the more likely the farm manager is to adopt new and more sustainable farm management practices (Bultena & Hoiberg 1983; Korsching 1983; Lee & Stewart 1983; Hefferman & Green 1986; Carlson & Dillman 1988; Norris & Batie 1989; Camboni & Napier 1993; Curtis & De Lacy 1996 & 1998; Witter at al 1996; Turrell & McGuffog 1997; Curtis & Van Nouhuys 1999). However, there is also evidence that smaller property sizes and the demands to create higher farm incomes lead to over use and depletion of resources (Beal, 1997).

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Indicator Data Source

The Agricultural Census/Agricultural Commodity Survey (ABS) and the Australian Agriculture and Grazing Industries Survey (ABARE) provide information on the area of landholdings for farms. The information is generally available at the SLA level.

Farm Ownership Characteristics (tenure)

Research has identified that more sustainable practices and investments are made for owned rather than rented farms (Pampel & van Es 1977; Korsching et al 1983; Lee & Stewart 1983; Lynne et al 1988; Norris & Batie 1989; Anosike & Coughenour 1990; Witter et al 1996).

Indicator Data Source

The Australian Agriculture and Grazing Industries Survey (ABARE) provides information on the type of farm tenure. This information is available at an SLA level, although dependent upon the number of data points within the SLA.

In addition the Agricultural Census/Agricultural Commodity Survey (ABS) identifies of the total farm holding, the percentage that is owned and occupied and the percentage of land that is leased or rented.

Farm Enterprise Mix

There appears to be good evidence, predominantly from the USA, to suggest that those farmers who have more diversified crop and livestock operations are most likely to also use more sustainable farm management practices (Pampel & van Es 1977; Ervin & Ervin 1982; Napier, Thraen, Gore & Goe, 1984; Norris &

Batie 1989; Anosike et al 1990; Sinden & King 1990; Camboni & Napier 1993; Saltiel et al 1994; Turrell & McGuffog, 1997). It appears likely that this may be related to attitudes where the farmer is more 'open' to experimentation with alternative mixes of produce and so may also more 'open' to alternative, sustainable practices.

Indicator Data Source

The Agriculture and Commodity Census (ABS), provides the most detailed information in relation to farm production and commodities including areas under pasture, cereal and other crops, plantation fruit trees, nursery, vegetables, livestock and farm forestry.

Employment of Non-Family Labour

Nowak (1987) identified that where farming enterprises have to employ non-farm family labour or hired labour, these farming enterprises, "may be too large for one person or family to manage or are complex and require specialised skill" (p. 212). Other studies that have emphasised and examined the relationship between the use of non-family or hired labour include those of Saltiel et al. (1994), Korsching et al (1983), Napier et al (1984) and Turell and McGuffog (1997).

Indicator Data Source

The Australian Agriculture and Grazing Industries Survey (ABARE) provides information on employment of non-family or hired labour on broadacre farming industries.

3.2. INSTITUTIONAL INDICATORS

It is important at the outset to clarify the meaning of the term institution that is used in this context and therefore the associated institutional indicators. The term institution is used specifically to refer to, a "system of norms to achieve some goal or activity that people feel is important" or "an organised system of social relationships which embodies certain common values and procedures and meets certain basic needs of society" (Horton & Hunt, 1984, p. 211-212). Given the previous discussion on sustainability as a social norm, institutions in this context represent those organised systems of social relationships that embody the goals, values and norms associated with sustainability. It is argued that the occurrence or prevalence of these institutions within a region or farming community will act specifically as change agents in the diffusion of sustainability norms and values throughout the farming community.

For the purpose of identifying and developing indicators in relation to these institutions within this research context, a distinction has been made between the formal and informal institutional structures operating with regions and communities. For example, the more formal institutions are found in farm extension, advisory, training, planning and other groups, associations and programs. On the other hand, the more informal institutional structures are apparent at the individual farm level and represent the organised pattern of networks and interrelations occurring in the farming community.

Formal Institutional Structures
(Farm Extension, Advisory, Training, Planning, Landcare and other Programs)

Many studies have shown that the greater the exposure of the farmer to sustainable practices, the greater the likelihood the farmer will adopt such practices (Korsching et al 1983; Napier et al 1984; Norris & Batie 1987; Nowak 1987). In a study of Landcare effectiveness, Curtis and De Lacy (1996) found that those farmers who maintained greater contact with their respective groups and had a higher involvement in Landcare activities, demonstrated greater levels of knowledge and understanding about sustainable practices.

It follows that awareness of sustainable land management practices would be greatest in those geographic areas and regions that have high levels of activity by these institutions. As one example, the existence of Landcare demonstration sites and highly active Landcare associations in an area makes it more likely that local farmers will be aware and influenced by messages 'diffused' through these institutions. Likewise, the greater the frequency and occurrence of training and advisory programs the more likely it will be that farmers will be influenced by sustainability messages 'diffused' by these institutions.

To some extent we are also arguing that the prevalence and activity of these institutions within an area legitimises sustainability as a normative pattern of farmer behaviour. This is not to say that all farmers would necessarily adopt sustainable practices in this case rather, there is an increased likelihood of adoption given the strong need within farming communities and other communities to conform to existing social norms.

Indicator Data Source

A historical and distributional review of the establishment of Landcare and other catchment groups together with a historical and distributional review of NSCP, NLP and NHT projects would provide an indication of the levels of institutional activity within specific geographic regions. Data should be collected from Commonwealth and State agencies, which identifies:

- The number and distribution of organised farm institutions within an area
  (Inc. Landcare, farmer organisations, farm co-operatives etc)
- Membership size of farm institutions
- Length of time institutions have operated in the area
- Number of farmer contacts and information requests

Landcare project officers estimate that there may be as many as 5,000 community Landcare groups across Australia, however, exact details are difficult to clarify as there is no national database of groups, nor have there been any detailed national surveys. NHT and group processes are administered at the state and territory government levels, which is where the most extensive records are maintained, however most do not attempt to keep detailed records of the activities of these groups. In fact, it is not clear, at this time as to how many groups there are. Estimates suggest that there may be as many as 1,500 in New South Wales, while there is likely to be only 70 such groups in the Northern Territory.

Most state databases have been established for mailing purposes only. As a result, the extent of information contained within them is limited. Tasmania and South Australia are now developing a GIS-based database, which it is anticipated, will become a far more extensive source of information on the activity and distribution of these groups.

What is more, the level of detail and the efficiency of record keeping vary from state to state. Fortunately, the state and territory agencies responsible for NHT project processing do have good information on the more established (endorsed and incorporated) Landcare groups by virtue of the project funding applications. These records would have to be examined to determine the exact location of the groups, the time since their establishment, their primary area of concern, their membership numbers and the nature of their activities. The number of Landcare coordinators should also be able to be determined from these agencies as well as their respective areas of concern.

It should also be noted that discussions with State Landcare Co-ordinators have indicated that such a project would be significant and important for land management in its own right.

Informal Institutional Structures and Networks (Inter-farm Density: Contact with Neighbours & Other Farmers)

It has been found that the greater the amount of contact farmers have with friends and neighbours, the greater is the potential for the dissemination of information about improved management practices (Saltiel et al 1994; Curtis & De Lacy 1996; Witter et al 1996). However, it is also argued that a level of institutional prevalence is also required in the area in order for sustainability norms to be initially diffused into the farming community. Farming communities in which there is a prevalence of institutions and which also have geographically relatively high levels of farming density, would be more likely to adopt sustainable practices than communities in which only one of these conditions operated. By determining the relative 'remoteness' or density of farming enterprises, it should be possible to use this as a proxy indicator for the intensity or frequency of farmer social networks.

Indicator Data Source

The Agricultural Census/Agricultural Commodity Survey (ACS) collects through annual surveys of 60,000 farming establishments and five yearly census information, the area of the landholding and number of establishments, which together may yield information on the density of farms within specific regions. This information is available at SLA level for the five yearly annual census.

Farm Remoteness

The distance to an information source has been shown to be a determining factor of adoption (Lindner et al 1982). A number of other studies have also noted the role that stock and station agents in particular, but also accountants and banks, have in the diffusion of innovative ideas (Thomas et al 1990; Curtis & De Lacy 1996; Coakes et al 1999). It has been argued that being able to access services and information from education, training and support services must be

important in assisting farmers and land managers to manage their land in a sustainable manner (Hooper 1998; Vanclay 1998).

Indicator Data Source

An accessibility and remoteness index of Australia (ARIA, 1999) has been developed by the National Key Centre for Social Applications of Geographical Information Systems (GISCA). This index which is available at the census collector district, postcode and SLA levels is based on the population size of regional centres and road distances to these centres. Information from the Agricultural Census and the census of Population and Housing could be used with the ARIA index to develop indices of the remoteness of specific farming enterprises from major service centres. A similar form of analysis has also been undertaken using ABARE survey information and reported previously by Garnut & Lim-Applegate (1998)

Access to Media

The role of the media had also been acknowledged as contributing significantly in raising awareness of sustainable land management practices (Korsching & Hoban 1990; Saltiel et al 1994). Trade magazines and Internet access have been identified as reliable sources of information. Vanclay (1998) notes that Internet access may be an indication general access to social services and telecommunications. Two points are noteworthy here; first, it could be considered that Internet access might be an indicator of how proactively the farming family is in seeking out information. Also, it may also be an indicator of the skill base within the farming family. It might suggest that the family is generally open to new ideas and prepared to make the effort to experiment and, of course, invest in such new technologies. Other studies have noted how a farmer's attitude to new skills and technology can indicate their potential to adopt sustainable land management practices (Carlson & Dillman 1988).

Indicator Data Source

The 1998-1999 Agriculture Commodity Survey (ABS) has three questions that are directed specifically at computer and Internet use. One question deals with computer ownership, a second related to the use of the Internet or World Wide Web, while a third question asks about intentions to connect to the Internet within the next 12 months.

The use of rural media and subscriptions to technical reports has also been investigated in the 1999 ABARE supplementary survey on Attitudes and Practices in the Livestock industry. While this information is limited to the livestock industry it may nevertheless be included as a useful adjunct to information on Internet access.

3.3. APPRAISAL INDICATORS

While the institutional indicators provide some index of the prevalence of institutions within the farming community and region and the likely diffusion of social norms related to sustainability, the extent and level of farmer participation in the activity of these organisations provides an additional indicator of the likely adoption of sustainable land management practices within a community or region. In particular it is suggested that the appraisal or recognition of land degradation and the recognition of the need to adopt sustainable land management practices will be highest amongst those farmers that participate in the activities of these institutions.

A study conducted by Buttel et al (1990) demonstrated a link between participation in community groups and the adoption of sustainable practices. Other studies investigating Landcare participation (Curtis & De Lacy, 1994; 1998) have also demonstrated this link. But, one other study showed that Landcare participants were significantly more involved as members of other voluntary community groups – in fact almost all Landcare respondents (98%) were members of other voluntary community groups (Curtis & Van Nouhuys 1999). As such there appears to be an association between volunteerism and the adoption of sustainable practices.

Ideally, measurement of this construct would be done by obtaining primary data on such variables as the level of group membership, the history of involvement (length of time individuals have been members of specific groups) and the level of contact between farmers and government extension agencies, advisory, training, Landcare and other programs.

Group Membership

Clark (1995) noted that activities that promote a sense of belonging, cooperation, neighbourliness, and unconditional acceptance, are those most likely to offer stability and encourage support for ecological sustainability. Pearce (1990) acknowledged the importance of social interaction that people gain from being members of community groups and how it is an important factor in motivating people to undertake community and environmental work. It follows then that the extent of group membership within a specified area would reveal the amount of social capital there is for such activity. This type of activity is nearly always voluntary and so it can also be seen to be a measure of altruism. Adoption of sustainable land management practices often implies an altruistic contribution, particularly where a practice is not known to deliver a profitable outcome.

Indicator Data Source

This information could be obtained from two primary areas. Given that information is required on the number and distribution of farm extension, advisory, training, planning, Landcare and other programs that operate in specific areas (Institutional Indicators), information could also be obtained concurrently and where appropriate on membership levels within these groups.

A second source of information is again to use information drawn from ABARE supplementary surveys including the Attitudes and Practices of Wool and Beef Producers (1997-1998), the Resource Management Supplementary Survey (1998-1999) and the Landcare and Land Management Survey (1995-1996).

Length of Group Involvement

Group membership alone is not always a good indicator of involvement and participation. Length of group involvement should also be used in addition to group membership it can be inferred that where there is a long history of membership, one might expect a more developed sense of community and further progress towards sustainability.

Indicator Data Source

The ABARE Resource Management Supplementary Survey (1998-1999) provides information on the length of time the farmer or property representative was a member of Landcare. In addition the ABARE supplementary survey on Attitudes and Practices of Wool and Beef Producers (1997-1998) and the Landcare and Land Management Survey (1995-1996) provides information on the extent of involvement in group activities.

Contact with Extension, Advisory, Training, Landcare and Other Programs

Many studies have revealed the important role that extension officers have in the diffusion of innovations (Taylor & Miller 1978; Korsching et al 1983; Nowak 1987; Norris & Batie 1989; Thomas et al 1990; Saltiel et al 1994; Curtis & De Lacy 1996). Principally, it is the access to information that significantly affects adoption. The influence of Landcare officers, in particular, has been recognised as one of the main reasons why Landcare has been so successful in raising awareness of land degradation issues (Macgregor & Pilgrim 1998).

Indicator Data Source

This information could be obtained from two primary areas. Given that information is required on the number and distribution of farm extension, advisory, training, planning, Landcare and other programs that operate in specific areas (Institutional Indicators), information could also be obtained concurrently on levels of farmer contacts with these organisations and groups.

A second source of information is again to use information drawn from ABARE supplementary surveys including the Attitudes and Practices of Wool and Beef Producers (1997-1998), the Resource Management Supplementary Survey (1998-1999) and the Landcare and Land Management Survey (1995-1996).

3.4. OTHER COMMUNITY LEVEL INDICATORS

In addition to indicators identified within the three component framework, it is also suggested that some broader assessment be made of community resilience and sensitivity to change. Farmers and the farm related institutions that have been identified and described do not exist in a vacuum independently of other social and community functions and structures. As indicated in Coakes et al (1999), there may well be some relationship between farmer adoption of sustainable practices and the general social condition of rural communities.

Given the ready availability of national data and indicators of rural advantage/disadvantage and community sensitivity to change, it would be worthwhile to explore the relationship between indicators within the three component framework and such broader community level indicators.

Rural Community Resilience and Sensitivity to Change

The research literature on community change and adaptation to change at a community level has identified a number of theoretical and conceptual areas that may be relevant, or at least interact with an individual's capacity to implement change. These models (Bowles, 1982; Blishen et al., 1979; Coakes, 1998; Coakes & Fenton, 1999; Lane et al., 1997; Kelly & Steed, 1998; Little & Krannich, 1988; Jones and Tonts, 1995), have identify several core dimensions or factors of community as a basis for modeling change, including those of (a) community health and vitality, (b) institutional vitality and integration, (c) political efficacy and (d) economic viability and resource sustainability

Indicator Data Source

The ABS can provide data level on socioeconomic disadvantage through its SEIFA96 (Socio-economic Indicators for Areas) at the Census Collector District (CCD) level (ABS, 1998). There are five indexes available:

- Urban index of relative socio-economic advantage
- Rural index of relative socio-economic advantage
- Index of relative socio-economic disadvantage
- Index of economic resources
- Index of education and occupation

Community Sensitivity Indices (CSI), which are similar to the SEIFA indices, have also been described and identified by Fenton (1998a, 1998b, 1999b) using population and housing census data at the census collector district level. Unlike the SEIFA indices these indices have been developed to show sensitivity to change in relation to four distinct dimensions, including (a) unemployment and income, (b) family and housing, (c) education and occupation and (d) age dependency. The indices have been used extensively to show the level of community and regional variations in vulnerability to change in relation to water resources (Fenton, 1999c; 1999d), forestry (Fenton, 1998a, 1998b, 1999b) and the dairy industry (Fenton, 1999e).

3.5. SUMMARY OF INDICATORS

Table 3.1 provides a summary of the indicators that have been identified in Section 3, including data source, data availability, whether the data is available as time series and the geographic coverage of the indicator and the associated data from which it is drawn.

As evident in Table 3.1 the majority of indicators selected for inclusion within the three component framework are readily accessible through existing data sources, although there will be some limited primary data collection required in identifying the prevalence of formal institutions within specific areas. The

majority of indicators are also available in time series allowing the identification of trends across previous years. In addition and given similar data collection procedures in the future, the majority of indicators can also be used within a monitoring framework. All indicators have either moderate or high national geographic coverage, with most indicators able to be derived at the SLA level or on the basis of an aggregation of several SLAs.

Table 3.1. Summary of Indicators

INDICATOR COMPONENT	Likely Direction	Data Source	Data Availability	Time Series	Geographic Coverage
INDIVIDUAL INDICATORS					
Age of Farmer	–	ABS,AAGIS, ADIS	High	High	High
Years of Farm Management Experience	+	AAGIS	Low	Low	Moderate
Farmer Education and Skill	+	ABS, AAGIS	High	High	High
Family Members Working on Farm	+	AAGIS	High	High	Moderate
Number of Children	+	ABS, AAGIS	High	High	High
Level of Farm Income	+	AAGIS, ADIS	High	High	Moderate
Level of Farm Debt	–	AAGIS, ADIS	High	High	Moderate
Level of Farm Profit	+	AAGIS, ADIS	High	High	Moderate
Level of Off-Farm Income	+ –	AAGIS, ADIS	High	High	Moderate
Farm Size	+	ACS, AAGIS, ADIS	High	High	High
Farm Ownership	+	ACS, AAGIS, ADIS	High	High	High
Farm Enterprise Mix	+	ACS, AAGIS, ADIS	High	High	High
Employment of Non Family Labour	+	AAGIS, ADIS	High	High	Moderate
INSTITUTIONAL INDICATORS					
Prevalence of Formal Institutions	+	PRIMARY	Moderate	Moderate	Moderate
Prevalence of Informal Institutional Networks	+	ACS, AAGIS *(derived)*	Moderate	High	Moderate
Farmer Remoteness	–	ACS, AAGIS *(derived)*	High	High	High
Access to Media	+	ACS, AAGIS	Low	Low	Moderate
APPRAISAL INDICATORS					
Group Membership	+	PRIMARY, AAGIS	High	Moderate	Moderate
Length of Group Involvement	+	PRIMARY, AAGIS	High	Low	Moderate
Level of Contact with Formal Institutions	+	PRIMARY, AAGIS	High	Moderate	Moderate
OTHER COMMUNITY LEVEL INDICATORS					
Rural Indices of Relative Advantage	+ –	ABS	High	High	High
Community Sensitivity to Change Indices	+	ABS	High	High	High

Notes: *Likely Direction: Likely direction of relationship with adoption of sustainable land management practices. Geographic coverage: High generally indicates coverage at CCD to SLA levels, Moderate indicates coverage at SLA or aggregation of 2-3 SLAs.*

Data source: ABS indicates ABS Population and Housing Census
ACS indicates ABS Agricultural Census
AAGIS indicates Australian Agriculture and Grazing Industry Survey and Supplementary Surveys (ABARE)
ADIS indicates Australian Dairy Industry Survey and Supplementary Surveys
PRIMARY indicates the need for some primary data collection

4. OPERATIONALISING THE FRAMEWORK

4.1. PILOT OR FEASIBILITY RESEARCH

As discussed previously many of the variables and constructs that have been identified as being related to the adoption of sustainable land management practices have been derived from methodologies based on survey research and primary data collection. With the exception of studies, such as those by SCARM (1998), there are very few studies that have used solely secondary data in assessing the potential of farmers to adopt sustainable practices. In addition and as also discussed in relation to several of the individual indicators, there are often competing research findings in relation to the direction of the relationship between the indicator and the likelihood of adoption.

For these reasons it is strongly recommended that feasibility or pilot research be undertaken to examine the extent to which the indicators that have been recommended are effective as predictors of the adoption of sustainable practices. The objectives of this initial study would be (a) to examine the effectiveness of the indicators as predictors of sustainability and (b) to provide some indication of the relative salience or importance of specific indicators. In relation to the latter point, it is clear that not all indicators identified will contribute equally in explaining adoption practices. Several of the indicators, while they may assist in predicting adoption, may nevertheless account for minimal variation in the adoption of sustainable practices, while other indicators may be extremely effective as predictors of adoption. The initial feasibility or pilot research would therefore also act to remove the less effective indicators prior to any large-scale data collection.

One of the difficulties in assessing how adequate specific indicators may be in predicting the adoption of sustainable land management practices is that, apart from the use of previous research as a guide, there is no certainty that the specific indicators that have been selected are necessarily important as predictors of adoption across different regions, localities and farming contexts. It is quite possible, as highlighted in Figure 2.5, that depending on the region and the characteristics of specific localities, farm types and environmental conditions, that specific and different adoption practices will be required in addressing sustainable land management issues across these different regions. For example, a region which has one type of environmental condition, may require the adoption of sustainable practices X,Y, and Z, while another region, which has a very different set of environmental conditions, may require the

adoption of sustainable practices A, B and C. Given that both regions are environmentally very different and may require the adoption of different sustainability practices, there is no reason to assume that all the indicators that have been identified will be of equal importance or that interactions and the direction of the relationships between indicator and adoption will be the same in predicting the adoption of specific practices.

It is recommended that a two phased approach be developed in relation to operationalising the framework and the development of Project 6.2.2. The first phase would include pilot survey research, while the second phase would include the collection, analysis and presentation of indicators as defined in section 3 of this report.

The pilot survey research would have two core objectives. Firstly, survey research would allow the identification of regions, which vary in levels of adoption of sustainable land management practices. Secondly, the pilot survey research would be used to develop a predictive model of the relationships between specific indicators and adoption. This in turn would enable assessments to be made regarding

- Key indicators
- The definition, source and time period for each relevant variable/indicator
- Future research directions for refining and further testing indicators where necessary
- Recommendations regarding changes/additions to existing data collections, for example, ABARE surveys, ABS AgCensus and Surveys and the Social Sciences Centre Rural Poll currently in development.

4.1.1. Identifying Variation of Adoption of Sustainable Practices

As indicated throughout this report, all previous research identifying predictors of adoption has focussed on the adoption of specific farming practices. There is currently no research, which has examined the adoption of sustainable land management practices in any generic sense and which is applicable across different farming types and land management contexts. One component of Phase I, would be to develop appropriate psychometric scales that are able to quantify generically the adoption of sustainable land management practices and which are generally applicable across different regions, farming types and environmental contexts and conditions. This would of course require the use of a number of scale items, including both intention to adopt and actual adoption, and from which composite scales could be derived.

It is suggested that six ABARE regions should be identified within Australia as a basis for undertaking the pilot survey research. ABARE regions should be used, as this is the spatial unit from which the majority of indicators derived from the Australian Agriculture and Grazing Industries Survey (ABARE) will be derived. Regions will be chosen to incorporate a variety of producer types, localities and communities. These regions will be outside the rangelands as a similar process will have been undertaken within Audit Project 2.2 (Socio-economic monitoring framework).

It is obviously important within the first phase of the research that the six regions are selected which are likely to have maximum variability in adoption of sustainable land management practices. The difficulty here is that the detailed variability in adoption across the six regions is largely unknown prior to undertaking the survey research. However, a guide to the selection of the six regions maybe to use the 1998-1999 Supplementary survey on Resource Management, completed as part of ABARE's survey of broadacre farming and the dairy industry, which includes a number of items related to the adoption of sustainable farming practices. An analysis of these items could be used to identify the six regions to be used in the pilot survey research.

4.1.2. Predictive Modelling

The survey research would also include specific variables, based on the indicators identified in this report and which are operationalised in the same way as they have been in other secondary data sources. For example, when assessing the level of farm income in the pilot survey research, the same question wording and structure should be used as that used in the ABARE Agriculture and Grazing Industry surveys. This approach would allow some understanding of how well the indicators identified in Phase II are able to predict adoption of sustainable land management practices.

Given that the pilot survey research has quantified adoption of sustainable management practices and that it also includes variables based on the indicators identified in this report a detailed analysis of the extent to which these variables predict adoption could then be undertaken. Testing the causal relationships and interactions amongst variables as predictors of adoption will be a complex analytic task requiring the use of multivariate statistical procedures and in particular the use of structural equation modelling (ie., Lisrel or AMOS).

While this analysis will be difficult, of equal difficulty will be the presentation of the outcomes of this analysis, which is accessible and understandable to the lay reader. An example of how this information may be presented for any specific indicator is shown in Appendix A.

4.2. EXISTING DATA SETS

In a review of the use of social data in the Audit, Vanclay (1998) suggests that the Audit "include as much of the ABS Census data, ABS Health data, and Farm Census data that it reasonably can; and that it investigate ways of including details about Landcare".

Independently of the recommendations of Vanclay (1998), the current review of potential indicators has reached the same conclusions. Namely that the ABS population and housing census and the Australian Agriculture and Grazing

Industries Survey (ABARE) are the two primary data sets that need to be utilised in the collection of indicators data and that where possible information on the occurrence and characteristics of Landcare groups should also be included.

4.2.1. Population and Housing Census (ABS)

The Australian Census of Population and Housing is an official count of population and dwellings, and collects details of age, sex and other characteristics of the population. The 1996 Census is the 13th national Census for Australia. One of the important features of the Census is that it allows different characteristics of an individual, family or household to be related through existing tabulations as found in CDATA96 or through the development of custom crosstabulations.

Benefits

There are three primary benefits to use of ABS Population and Housing census information. They include (a) the information is time series, (b) there is detailed Australia wide geographic coverage at the census collector district level and (c) the information is derived from a census and is not based on sample surveys. That the census is able to provide backwards and forwards time series estimates is particularly important and enables information to be used and developed in a monitoring framework. **Something re the social atlas but need cross tabs too?**

Weaknesses

One of the most obvious weaknesses in using the ABS population and housing census is that the census is not specifically directed at farmers or farming enterprises and that therefore considerable effort will be required in developing crosstabulation for specific variables. It is also important to recognise that although census information is available at the census collector district (CCDs) level, custom crosstabulations based on CCD level information will invariably produce low cell counts which may be subject to data randomisation procedures introduced by ABS. As such SLA or some aggregation of CCDs maybe required when developing custom crosstabulations.

4.2.2. Agricultural Census/Agricultural Commodity Survey

The Agricultural Census/Agricultural Commodity survey (ACS) is the primary source of Australian commodity statistics and is conducted at the end of March each year. It collects information from agricultural enterprises that have agricultural production in the form of crops, fruit, vegetables or livestock. Every fifth year, information is collected through a mail survey of approximately 150,000 farming establishments, with the next data collection exercise planned for 2001-2002. In the intervening years, a survey of up to 60,000 establishments provides estimates of production and area. Broadly data collected includes information on area of holding, number of establishments,

production areas, number of livestock, wool production, land use, fertiliser usage, irrigation and land management and environmental aspects.

Benefits

Time series information is available from the agricultural census, which is undertaken every five years. Information is also available at the SLA level and unlike the ABARE agriculture and grazing industry survey covers a broad cross-section of farm types.

Weaknesses

While census data is available for each agricultural census year at the SLA level, survey information drawn from the inter-census years is not available at SLA level due to low sample counts. The Agricultural census has as its focus the collection of commodity and production statistics and has limited direct information on the social and demographic characteristics of farmers or farming enterprises.

4.2.3. Australian Agriculture and Grazing Industries Survey (ABARE)

The Australian Agriculture and Grazing Industries Survey (AAGIS) and the Australian Dairy Industry Survey (ADIS) are undertaken on an annual basis. They cover dairy farming and five broadacre industries, including (a) wheat and other crops industry, (b) mixed-livestock crops industry, (c) sheep industry, (d) beef industry and the (e) sheep-beef industry. Survey information and data are collected by both personal and telephone interviews from 1,400 to 1,700 farming enterprises. Information collected as part of this survey is particularly useful as it includes a broad range of socio-economic data including land area and tenure, sharefarming, labour, farm family characteristics, farm capital, crop type and production, fertiliser use, irrigation, farm receipts, farm costs, farm performance measures, farm debt and farm equity.

It should also be noted that in addition to conducting annual AAGIS and ADIS surveys, during the 1990s ABARE has undertaken several supplementary surveys focussing on issues related to land management, sustainability and related programs. These surveys may provide additional and specific data for regions in relation to identifying indicators of sustainable land management practices. These supplementary surveys include:

Resource Management (1998-1999)

- Presence, extent, and costs of degradation
- Participation in training
- Landcare membership and involvement in Landcare activities
- Contents and use of farm plans
- Cost of land care capital works
- Adoption of best practices in farm management
- General and zone specific questions (30 practices in total)
- Area of crops sown with different tillage practices
- Recent changes to tillage practices, and motivation for change

- Attitudes to degradation and conservation (developed in conjunction with the Social Sciences Centre, BRS)
- Farm forestry information, functions of trees on farms

Attitudes and Practices of Wool and Beef Producers (1997-1998)

- Farm management practices and attitudes
- Land sustainability and training activities, and
- Farmers' participation in group activities and management systems

Landcare and Land Management (1995-1996)

- Use and value of sources of farm management information
- Participation in training activities
- Landcare membership, level of involvement, most valued activities, reasons for non-membership
- Property Management Planning (existence of farm plans, elements included in the plan, use of the PMP)
- Adoption of a number of best farm management practices
- Extent of land degradation on farm properties
- Progress with on-farm capital works relating to Landcare

Landcare and Land Management (1992-1993)

- Taxation (amount of eligible expenditure under Sections 75B and 75D, amount claimed, reasons for not claiming, perceived importance of tax concessions)
- Property Management Planning (existence of farm plans, elements included in the plan, activities performed as part of the plan, use of the PMP)
- Awareness of land degradation
- What farm practices are part of their normal farm management program,
- Landcare groups (membership, reasons for non-membership, valued activities)
- Awareness of the NLP and participation in NLP projects

Land and Drought Management (1991-1992)

- Landcare membership
- Farm planning
- Presence of, and attitudes to, land degradation problems on farms
- Drought preparedness strategies
- Drought management strategies
- Attitudes to farm and land management issues

Benefits

There are significant benefits to be derived from using the AAGIS and ADIS and where appropriate supplementary information included in these surveys. Firstly specific social variables, including the characteristics of farmers, their households, and on and off-farm employment have been collected annually since 1977-1978. As such there is considerable time series information to be

found within these data sets. Secondly, the type of information collected in these surveys covers many issues of particular relevance to the indicators identified and developed in this project. This is particularly so when relationships between the ABARE supplementary surveys are examined in the context of the annual AAGIS and ADIS surveys.

Weaknesses

The primary weakness with the AAGIS and ADIS is that information is drawn from only broadacre and dairy farms with a specific value of agricultural production. For instance, for the 1996-1997 surveys this included all farms with an estimated annual value associated with agricultural operations of $22,500 or more. Although these surveys focus on broadacre and dairy farms, it is estimated that this comprised nearly three-quarters all farm businesses of a commercial size in 1996-97 (Garnaut & Lim-Applegate, 1998)

A second weakness of the AAGIS and ADIS surveys is that while data is readily available for broadacre zones and regions and can be aggregated to agro-economic regions, development of indicators from this data at a finer geographic scale may in some cases be limited. Local government area and latitude and longitude information are coded for each farm so that it is also possible to provide data for any group of farms defined by reference to local government area or geographic location. While in some cases aggregation to LGA or SLA level may be appropriate, in other cases and depending on sample sizes, specific LGAs or SLAs may need to be aggregated further.

In addition, while information drawn from the supplementary surveys may be very useful, the supplementary surveys are generally one-off surveys and as such time series data is not readily available. In addition, and given recent changes in the agricultural sector, the use of information from supplementary surveys prior to 1996 while useful in exploring possible trends and comparing with other more recent datasets maybe of limited benefit.

4.2.4. Inventory of Farm Extension, Advisory, Training, Planning, Landcare and Other Programs

The assessment of these institutions operating within specific farming regions and communities does require some primary data collection. However, this is the only indicator for which some primary data collection maybe required. For the most part this assessment can be undertaken relatively efficiently by working through State government agencies responsible for and associated with these organisations. Existing databases from these agencies would generally provide a starting point for the assessment, and where gaps in the data requirements hare found this may require further consultations with the more local agencies and groups.

As indicated previously, several State agencies are already developing geographically referenced coverages of the location of Landcare groups and State agencies associated with Primary Industries and Environment would be able to provide profiles of their operations within specific areas.

4.2.5. Units of Analysis

There are two important issues relating to the analysis and presentation of data in 6.2.2.

Ecological fallacies

The first of these relates to the testing or development of the model for identifying the links between social and economic variables and sustainable resource management practice and/or resource condition. In technical terms it is referred to as an 'ecological fallacy'. This arises from a mismatch of units of analysis. An ecological fallacy occurs when conclusions are drawn about individuals based only on analyses of group data. For example, making assumptions about an individual's height based on the average height of a group to which that individual belongs – or making assumptions about farmers in a region based on averaged region level information.

In other words, there is a poor fit between units for which there is empirical evidence and the units for which statements are to be made. Specifically, this problem occurs when data is collected at an aggregated unit of analysis (such as an ABARE region) but generalisations are made about lower or disaggregated units (eg SLAs). It is a fallacy because what happens in one unit of analysis does not always hold for a different unit of analysis (Hannan, 1985).

In Phase I, in order to undertake valid study of relationships between social indicator variables and individual adoption of sustainable practice variables it will be necessary to analyse variables for which data is available to ABARE (from survey data) at a unit level of analysis rather than at the regional or sub-regional aggregated level of analysis. Given restrictions on access to both ABARE and ABS unit record data, this will involve commissioning, for example, ABARE to carry out the statistical analysis. However, given the nature of the analysis involved, ABARE/ABS would require expert assistance in programming and carrying out this analysis.

Framework for integrating differing geographic units of analysis

A significant proportion of the data for project 6.2.2 will be drawn from ABARE survey data and this data is generally only provided at the ABARE region level. This presents difficulties in providing data and information at the finer geographic units of analysis likely to be require by many potential users of 6.2.2 products who may require data at, for example, Statistical Local Areas, catchments, Local Government Areas etc.

While there is no perfect statistical method for disaggregating data to smaller geographic units, there are a variety of statistical approaches that could be used. For example, If years of experience in farm management is a variable which is only available at the ABARE region level, it may be possible to develop a surrogate indicator based on farmer age which is available through

the ABS at SLA level. However, these adjustments rely on assumptions that may not be able to be readily verified. Therefore these techniques should be limited to key indicators and should be used to identify future research priorities aimed at verifying/refining these indicators.

Problems related to displaying statistics collected using one set of boundaries against a second set of boundaries (for example, displaying ABARE survey data against IBRA region boundaries), are traditionally resolved by developing concordances. A range of concordance methodologies currently being developed by BRS will resolve these issues for Audit projects 5.1 and 6.2.2. Again, the use of concordance methodologies requires the use of assumptions that may not be true in practice. For example, if an IBRA region cuts an ABARE region in half, the assumption may be made that the value of the given variable for that region (eg gross value of production) could be divided exactly in half to derive the proportion of the variable to be ascribed to the IBRA region. However, it may be that in reality 80% of gross value of production is produced in 20% of the ABARE region.

Despite these difficulties, concordances and the development o f proxy indicators to enable data disaggregation are accepted techniques and provided they are expertly applied and described provide the best mechanisms for enabling data display against different units of analysis.

5. INTEGRATION AND APPLICATION OF THE FRAMEWORK

5.1. INTEGRATION OF SOCIAL, ECONOMIC AND BIOPHYSICAL INFORMATION

In relation to Audit Project 6.2.2 and other Audit Projects data are to be integrated through the application of Geographic Information Systems (GIS) allowing spatial analyses to be undertaken showing relationship across each of the social, economic and biophysical domains.

The integration of social, economic and biophysical information through a Geographic Information System has not, particularly at the national and regional scales, been previously applied in the natural resource management context. The use of social data in a GIS system is most often confined to the thematic display demographic information, as for example has been undertaken with the ABS census for a number of years. More recently, the Bureau of Rural Sciences project, Revaluing Rural Australia, trialed the integration of economic, biophysical and social indicators on a GIS platform and using visualisation technologies.

One of the principle problems likely to emerge in the integration of data from each of the three domains concerns the spatial units at which data is collected. Social and economic units of analysis are generally based on census collector districts (CCDs), Local Government Areas (LGAs), Statistical Local Areas (SLAs) or other administrative boundaries. While these units of analysis are problematic for social and economic data, as they do not always conform to relevant social catchments or functional social or economic units (Fenton 1998b; 1998c), they are in most cases certainly not the unit of analysis for biophysical data. In addition, biophysical information is often available at a spatial scale that has a much finer geographic resolution than social or economic data, and in many instances maybe based on raster rather than vector models.

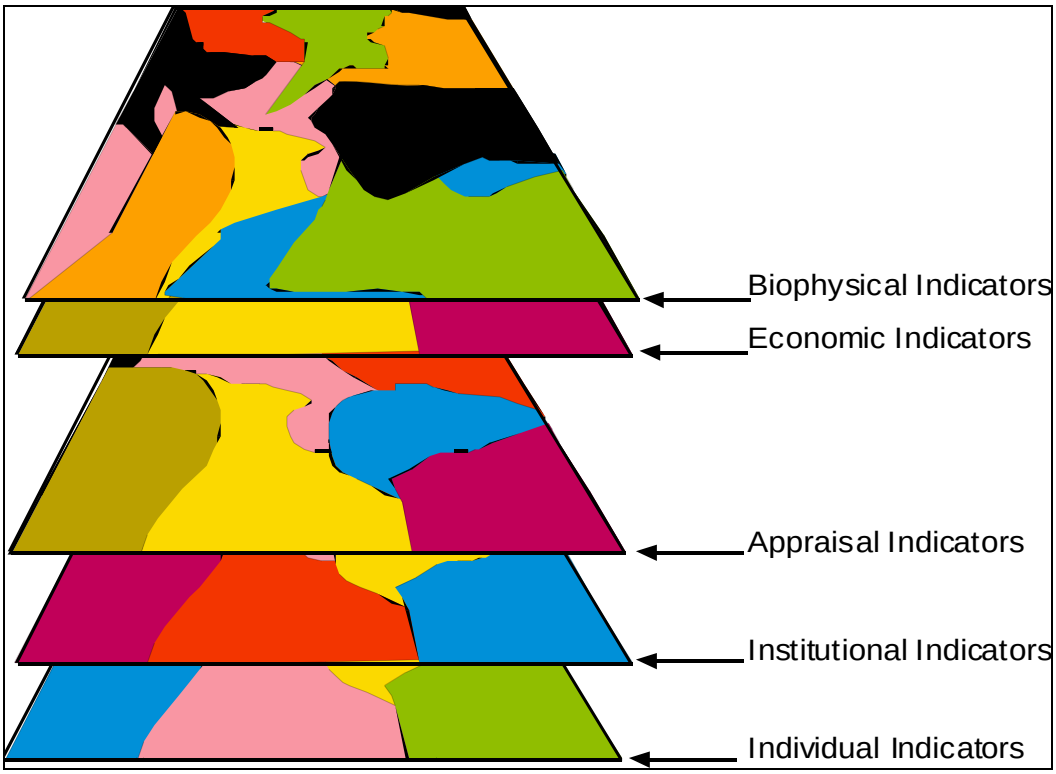
Certainly to maintain consistency across spatial units within each of the three domains would be problematic and time consuming giving rise to as many data manipulation and integration problems with no consistency across spatial units. The approach adopted throughout this report when identifying appropriate indicators has been to consistently use those data sources that allow the finest unit of analysis possible. Using this approach where possible maximises the level of congruity between biophysical, social and economic information

embedded within a GIS. Such an approach also permits, where appropriate, social and economic information to be aggregated upwards to larger units of analysis.

In addition, if all 20 indicators which are included in the three component framework are assessed, this would lead to 20 social indicators represented as individual layers or themes within the GIS. It is undoubtedly the case that several of the indicators may be highly correlated. Data reduction, including for example principal components analysis, would be required in the first instance in order to identify inter-correlations across the indicators. On the basis of this analysis several composite indicators, consisting of those indicators with high inter-correlations could be defined. This would reduce the set of 20 indicators and at the same time improve the reliability of specific indicators through the use of a composite. It may well be that this type of analysis does not yield a structure that conforms to the three component framework which has been defined on a priori theoretical grounds. It may define some other structure, which through the use of composite indicators, has greater reliability and predictive validity as an indicator of the motivation and capacity to change towards sustainable management practices.

As an example, in terms of the indicators and framework that have been identified, it is argued that application of indicators within the three component framework would provide three reasonably generic layers (individual, institutional and appraisal) for inclusion within a GIS platform. Figure 5.1 shows schematically the integration of the three components of the indicator framework within a GIS.

Figure 5.1 Example of Three Component Framework as GIS Layers



5.2. DIRECTIONS FOR THE DEVELOPMENT OF PROJECT 6.2.2

The objective of Project 6.2.2 is to provide, on a GIS platform, social, economic and natural resource economic data relevant to understanding the capacity of individuals and communities to respond to and implement change relevant towards sustainable land and water management.

This project would build on other Theme 6 and Audit projects and will identify relevant relationships between social factors and observed natural resource conditions.

Project 6.2.2 will develop a full range of cost-effective indicators needed as input to policy development and evaluation of natural resource management. The core objectives of this project are to:

- establish an ongoing national framework of social and resource economic data relevant to sustainable land and water management. Responsibility for data sets is likely to be distributed among several organisations but this will not affect access to the data sets;
- compile, develop and arrange access to social and resource economic datasets using a GIS platform; provide a comprehensive assessment and analysis of spatial and temporal trends in the indicators developed and report on the relationships identified and other findings – and their implications – for policy development.

The initial tasks of the project will be to:

1. negotiate issues related to data access with organisations that currently hold data required for the project,
2. identify metadata requirements and procedures for the project,
3. identify the appropriate reporting format,
4. identify appropriate institutional arrangements for data storage and continuous monitoring and updating of Project 6.2.2 data,
5. identify the needs and requirements of stakeholders who may use and access information from the project, and
6. identify which institution(s) would be the data custodians for the project.

Consideration will need to be given to what core biophysical data from other Audit theme projects should be included within the project. Clearly this needs to represent the 'natural resource conditions' that are directly related to sustainability and land use. For instance, SCARM (1998) included a number of resource conditions in the development of indicators of resource condition

which included for instance, nutrient balance, soil acidity and sodicity, salinity and vegetation biodiversity. In addition, and given that it is human use and interaction with the environment that is being investigated, there would be an obvious need for information on landuse and land tenure to be included.

In relation to the social indicators identified in this report a decision would also have to be made, primarily on the basis of data availability, accessibility and cost, as to the time intervals to be used for time series data. This would not only be important in identifying relative changes in the social indicators, but also in interpreting the relationship between the social and biophysical indicators. Many of the biophysical and social indicators may be derived and based on data at different time periods and as such time lags may need to be interpreted when evaluating any relationship between these indicators.

An additional and important consideration, as discussed previously in this report, is the spatial scale at which social indicators data is obtained. As has been argued, the social data should be obtained at the finest grain possible, and in the context of the datasets to be used (Section 4), this would appear to be at the SLA level or some aggregation of SLAs.

As discussed in Section 4.1 of this report there is also a need to undertake pilot research using the social indicators identified in this report. The objectives of the pilot research would be to examine the effectiveness of the indicators as predictors of sustainability, to provide some indication of the relative salience or importance of specific indicators and to identify issues and problems associated with the use of existing data sets when deriving indicators.

5.3. IMPLEMENTING PROJECT 6.2.2

Implementing Project 6.2.2 would involve two phases. Phase I of Project 6.2.2 would require detailed survey research in relation to the specific indicators in order to identify the strength, direction and interaction with other indicators in the prediction of sustainable land management practices. The following specific tasks would be included in Phase I and Phase II of Project 6.2.2. The scope of tasks included in Phase I and II are such that several of the tasks within each phase could be undertaken concurrently.

Phase I: Tasks

1. Identification of six ABARE regions, which through the ABARE Supplementary survey on resource management have significant variation in relation to the adoption of sustainable land management practices.
2. Development of a telephone questionnaire, which includes:
   (a) Indicators identified in Section 4 and which are operationalised using the same questions or question wording as found in the Australian Agriculture and Grazing Industry Surveys or other secondary data sources in which these indicators are found.
   (b) Scale items in relation to the adoption of sustainable land management practices, which through data analysis can be used to identify

composite measures of the adoption of sustainable land management practices. (See Point 3 in **Phase II Tasks**, below.)

(c) Primary data collection within each of the six regions in relation to appraisal and institutional indicators (Table 3.1)

3. Development of a: sampling frame for the survey of farmers within each of the six regions.
4. Pre-testing and analysis of survey methodology and questionnaire on a sample of 100 farmers.
5. Undertake telephone survey of 1,800 farming properties, which would include a sample of 300 farming properties from each of the six regions.
6. Analysis, reporting and presentation of results using appropriate uni-variate statistical analyses and, specifically, structural equation modelling in relation to the adoption of sustainable land management practices. This may require subcontracting ABARE and/or the ABS to carry out these analyses under instruction to enable the use of unit record data in the analysis.

Phase II: Tasks

1. Secondary data acquisition from ABS and AAGIS data sources for each indicator identified in Table 3.1 at a national scale using appropriate spatial units. Where appropriate time series information for each of the indicators should also be collected (at a minimum three previous time intervals). Initial estimates from ABS and ABARE indicate that costs for data provision would be in the order of $10,000 in total.
2. Development of proxy indicators to enable finer geographical unit analysis where necessary.
3. Primary data collection in relation to the institutional and appraisal indicators as identified in Table 3.1 for ABARE broadacre farming regions.
4. Integration of environmental data (reflecting sustainable resource management), the adoption of recommended NRM practices and the individual, institutional and appraisal indicators (see Figure 2.5). It is recognised that this task is difficult, particularly in the Rangelands, because of the need to separate human-induced components of change from natural variation, such as short and medium term rainfall variability. The Phase II study should consider the following non-exhaustive list of desirable NRM practices which will have differential applicability in different areas of Australia:
   - Use of conservation tillage and reduced tillage systems
   - Maintenance of soil cover
   - Use of ley pasture phases (or substitutes) in cropping systems
   - Adjusting crop sequences in response to seasonal conditions
   - Nutrient balance accounting
   - Tactical nutrient adjustment (soil and plant sampling)
   - Establishing and monitoring ground cover targets
   - Erosion management
   - Use of deep-rooted perennial pastures
   - Non-commercial and commercial tree and shrub planting
   - Retention of vegetation along drainage lines
   - Irrigation scheduling
   - Appropriate stock retention (fencing) policies

- Appropriate effluent disposal systems

5. Development of the Social Atlas. With the inclusion of Project 4.2.2. the social atlas will include the whole of Australia.
   (a) Introduction including the objectives of the social atlas.
   (b) Methodology, including Phase I and Phase II methodology.
   (c) Research outcomes from Phase I, including the presentation of overall predictive models and composite scales of adoption of sustainable land management practices.
   (d) For each indicator, using a similar template as shown in Appendix A, present:
      - Appropriate spatial maps for each indicator and, where appropriate, time series maps.
      - Bullet point summary commentaries for each map.
      - A detailed commentary on each indicator and, where appropriate, identify Australian data and research where the indicator has also been used.
      - From the structural equation modelling undertaken in Phase I, present the results of this analysis for each indicator in a form which is understandable and usable to lay readers.
6. Development of Web based Social Atlas and Database. This should include all information that is available in the hardcopy social atlas but which, in addition, allows:
   (a) queries to be undertaken for specific geographic regions and areas,
   (b) queries to be undertaken for specific indicators,
   (c) an analysis of spatial interactions amongst indicator variables nationally and within specific regions,
   (d) integration with other available biophysical and economic datasets which may be available, and
   (e) permits the atlas and database to be updated at regular intervals.

Linking the Rangelands Project 4.2.3 with Project 6.2.2

The Rangeland monitoring component of the Audit will seek ways to report trends in the socio-economic and institutional factors that affect the ability of rural communities to use and manage the rangeland so as to preserve options for future generations. The output of Project 4.2.3 is concerned with the identification of key attributes or indicators that depict social, economic and institutional factors affecting the sustainable management of rangeland ecosystems. The task in Project 4.2.3 is to assemble trend data on identified indices and develop routines to produce summaries according to the national rangeland ecosystem function framework. This task complements the objectives of Project 6.2.2 – *vis* to develop and arrange access to social and resource economic datasets using a GIS platform and to assess spatial and temporal trends in indicators developed and report on relationships identified.

In the Rangelands landscape cover (and the nature of the cover) is a more comprehensive and more universally applicable biophysical indicator of resource health than any single biophysical indicator for non-rangelands areas of Australia. As one of the objectives of the Rangeland Implementation project is to demonstrate methods for rangeland monitoring, using temporal Landsat data sequences over disparate biogeographical regions using Landscape Cover Change Analysis (LCCA), LCCA will be an appropriate indicator to incorporate

into a GIS platform. The LCCA data set could be mapped along with social and economic data relevant to the Rangelands and compatible with data collections for Project 6.2.2.

Combination of the data collections of Project 4.2.3 with Project 6.2.2 will allow more efficient development and testing of any deductive models of association between social and economic data and sustainable land management practices or surrogates for sustainable land management practices. It will also allow 'internal' comparisons between the effectiveness of modeled associations of a wider range of biophysical indicators and relevant socio-economic indicators.

In a combination of Project 4.2.3 with Project 6.2.2 it is proposed that data collections for Project 4.2.3 be as equivalent as possible to the data collections for Project 6.2.2.

The pilot testing proposed in Phase I of Project 6.2.2. in non-rangeland areas of Australia will have been previously accomplished for the Rangelands in the pastoralist survey to be undertaken as part of Project 4.2.1. This Rangelands survey data can be further utilised in a combined Project 4.2.3 and Project 6.2.2. The Rangelands component of the combined project should use this survey data to further test and validate the relationships between social indicators and reported sustainable management practices (available from Project 4.2.1) and biophysical indicators of ecosystem function (available from Project 4.2.2). The LCCA data provided from Project 4.2.2 (Change in Rangeland land use – QLD Department of Natural Resources) will be available for all of the Rangelands. The pilot study areas for which survey data will be available (from Project 4.2.1) are the Barkly Tableland (Mitchell Grass IBRA Region 41), the adjacent Gulf Country, and the Gascoyne–Murchison area (to the Great Sandy Desert, Western Australia).

5.4. PROJECT 6.2.2 OUTCOMES AND PRODUCTS

The project outcomes and products should be broadly applicable and useful to several user groups including those involved in environmental policy, management and research. Examples of the range of user groups to which outcomes and products maybe useful include the following:

a) **Politicians:** Provide an understanding of basic issues applicable to specific regions and which allow core issues to be identified to guide the development of environmental and agricultural policies.
b) **Agencies and Program Managers:** Provide an understanding of issues of relevance to program planning and management and which may guide the development of environmental policies within specific regions or environmental contexts.
c) **Agricultural Businesses:** Provide an understanding of important indicators underpinning agricultural businesses and enterprises within specific regions leading to increased efficiency and improved environmental practices.

d) **General Community and Community Groups:** As an information source for communities and community groups to better understand the role of social and economic factors in land management and assist in the development of community based initiatives and programs in land management.
e) **Researchers:** Provide a basis for identifying research, data and information needs in addressing environmental issues at both a regional and national scale.

In addressing the diverse interests of potential users it is suggested that two core products be developed from project 6.2.2. This would include a hard copy social atlas and a web based database and atlas. The web atlas and database would allow database queries and analyses to be undertaken which would not otherwise be possible in a hard copy social atlas.

Social Atlas

The social atlas should provide sufficient information that it is able to address as far as practical the information needs of potential user groups as previously identified. To this end the social atlas should provide:

a) a spatial (map based) description of specific indicators which is readily and easily interpretable,
b) a summary and detailed commentary on the indicator and its relationship to the adoption of sustainable land management practices, and
c) given the sometimes complex relationship between a specific indicator and adoption, the social atlas should provide an indication of the strength and direction of this relationship and how the indicator may, through its interaction with other indicators, predict the adoption of sustainable land management practices.

An example of the format and content of the social atlas is provided in Appendix A. In this example age has been used to illustrate how information in relation to one indicator may be presented.

A spatial map of the distribution of farmer age has been presented and in this example it is shown in relation to SLA boundaries as derived from the 1996 ABS census. It is also possible to derive this indicator from the AAGIS surveys undertaken by ABARE and it would also be possible using ABS or ABARE information to show changes in age across different time periods. Where separate data sources are available for a specific indicator, as is the case in relation to age, separate maps should be provided so as to allow the information to be useful to as broad a number of user groups as possible.

Appendix A also shows how a detailed commentary on each indicator may be presented. In this example, a summary is provided of the relationship between age and adoption as identified in previous research. In addition, Appendix A also provides references, where appropriate, to specific Australian studies that have examined the relationship between age and adoption.

In addition to the detailed commentary and spatial map, one of the most difficult issues will be the presentation of information on the strength and direction of the relationship between the indicator and adoption of sustainable land management practices. This component of the presentation will require careful consideration as, (a) the often complex analysis undertaken through structural equation modelling will have to be presented in a way that is understandable by very different users of the atlas and (b) the relationship may not often be simple and direct, but may be mediated or influenced by other indicators. Appendix A provides one example of how this information may be presented using a simple path diagram and causal relationships which are identified as simply strong, medium and weak. More detailed statistical information on these causal relationship should be presented, but in an appendix to the social atlas.

Clearly a hard copy social atlas can only provide relatively static information in relation to specific indicators. Many users may require more dynamic access to information presented in the social atlas in relation to both analysis and queries of the spatial data.

Web Atlas and Database

To better address the needs of a wide range of users; to allow user initiated analysis of information and to allow wider access to information and outcomes developed in Project 6.2.2 it is recommended that a web based social atlas and database should be developed.

The web based atlas and database would include all information presented in the hardcopy atlas, but also allow focussed analysis on specific regions and spatial units as required by the user. In addition, database queries would be permitted allowing users to examine detailed spatial relationships and interactions amongst indicators. This will require the use of concordance methodologies. Detailed commentaries on specific indicators as found in the hard-copy social atlas should also be included in the Web Atlas and database and presented as an option as part of the query based system that is implemented.

One of the most important functions of the web atlas and database would be to allow users to focus on specific geographic regions of interest and to examine individual indicators and their interactions within these regions. It is often the case that in hard copy atlases of the type proposed for Project 6.2.2, that detailed regional analyses can not be presented effectively and efficiently due to the national scale at which data in the atlas is presented.

Where spatial information is available in relation to environmental conditions (ie., nutrient balance, soil acidity and sodicity, salinity or vegetation biodiversity), this information may also be included allowing an examination of the relationships between environmental conditions and specific social indicators.

Expertise required to undertake project 6.2.2

Project 6.2.2 will require expertise in the following areas

- Social survey design and analysis
- Statistical analysis, including structural equation modelling
- The application of GIS technology to social data and to the integration of social, economic and biophysical data
- Access to appropriate social data bases / data sets
- Understanding of measurement theory related to the development and testing of social indicators
- Professional experience in undertaking research on social factors influencing land management practices

The complexity of the project and the lack of existing understandings of social factors influencing capacity to change mean that high quality expertise and experience in these areas is essential to achieving a successful outcome.

5.5. APPLICATION TO DECISION SUPPORT AND POLICY DEVELOPMENT

The approach and framework that has been developed in this report is particularly significant in relation to policy development. Given that indicators have been identified within the three component model it is possible to describe specific regions on the basis of these three components and to examine relationships between indicators within these components and the biophysical and economic conditions of the region.

For example regions which are 'poor' in terms of their biophysical condition can also be examined in relation to indicators of farmer capacity and motivation to adopt sustainable land management practices. Not only does the framework provide an indication of whether the region is also 'relatively low' in terms of capacity and motivation, but it also provides some indication of the underlying reasons as to why the region may have low levels of capacity and motivation. It may well be that the region is `relatively high' in terms of indicators within the individual component (i.e., high farm profits, education and skill levels), but that it is 'relatively low' in relation to the institutional and appraisal indicators. Similarly, time series analyses within the region may also indicate that indicators within the individual component have been generally increasing, while the institutional and appraisal indicators have remained relatively stable or have been declining.

Information of this type is critically important in relation to policy development for such a region, and in this example would suggest the need for broad policy development which encourages or builds capacity within the institutions in the region. In addition, assuming a policy change has been initiated for the region, the indicators themselves can be monitored across time in order to determine the effectiveness of changes to policy or new policies. The ability to monitor change within the framework that has been developed is only possible as particular attention has been paid to the selection of indicators which will allow time series analyses to be undertaken.

The framework approach that has been described is not only important for regional policy development, but would also provide significant support to those farmer, farmer support and environmental institutions that are operating within a specific region. These institutions would not only be able more clearly direct their programs and initiatives but would also be able to monitor their effectiveness over time.

GLOSSARY OF TERMS USED

Adoption	Adoption is the decision to continue full use of a new innovation or farming practice
Adoption Process	The adoption process is the cognitive and behavioural process that individuals move through from the time of initial awareness to adoption. The adoption process is generally considered to include five stages: awareness, interest, evaluation, trial and adoption
Appraisal Indicators	Represents those indicators used to describe characteristics of farmer and land manager interactions with formal and informal institutions, leading to greater awareness, recognition and appraisal of land and water degradation issues and sustainable practices.
Capacity	Generally synonymous with ability, to the extent that one has the capacity or ability to undertake specific behaviours or to change behaviour towards specific goals.
Composite Indicators	Rather than relying on a single indicator variable for a specific construct, construct validity can be improved by aggregating several indicator variables together yielding a composite indicator for a specific construct of interest.
Constructs	Used to describe the less tangible, concrete or objective characteristics on which individuals and farmers may vary.
Diffusion	Diffusion is the process by which innovations, new practices, beliefs or social norms spread through formal and informal institutions.
Indicators	An indicator implies an interest, not in the attribute that is being directly quantified, but an interest in a variable or construct which cannot be directly quantified. Indicators are able to be monitored across time, are capable of being disaggregated and should be embedded in a conceptual or theoretical framework
Individual Indicators	Represents those indicators used to describe individual farmer or farm characteristics, important in identifying motivation and change towards sustainable land and water management practices.

Institutional Indicators	Represents those indicators used to describe the prevalence, characteristics and activity of formal and informal institutions, important in identifying motivation and change towards sustainable land and water management practices.
Institutions	A system of norms to achieve some goal or activity that people feel is important. An organised system of social relationships which embodies certain common values and procedures and meets certain basic needs of society

Motivation	The set of processes that energise a person's behaviour and direct it towards attaining a specific goal.
Predictive Validity	The extent to which one or more indicators are able to explain or predict variation in the adoption of sustainable land and water management practices.
Proxy Indicators	Used to describe an indicator which itself is an 'indicator of an indicator'.
Relative Indicators	Used in when interpreting and comparing indicators. Relative indicators maybe be interpreted relative to different time periods or relative to other geographic regions.
Social Capital	An aspect of social organisation that includes trust, norms and networks, which together enhance cooperative actions towards specific goals
Social Norms	A social norm defines the behaviour that a number of people ordinarily expect or require of others. The behavior defined by social norms is generally accompanied by an element of 'ought to ' or 'must'.
Structural Equation Modelling	Models that are used to specify a system under study in terms of putative (often not directly observable) cause and effect variables and their (observable) indicators. Because each equation in the model represents a causal link rather than a mere empirical association, the structural parameters do not, in general, coincide with coefficients of regressions among observed variables.
Sustainability	There are numerous definitions what constitutes sustainability. A commonly accepted definition is that sustainable development must meet the needs of the present generation without compromising the ability of future generations to meet their needs (WCED 1987). Sustainability it has been argued is an emerging social norm guiding behaviours and beliefs in land management and use.
Threshold Indicators	Indicators which are interpreted using a specific critical threshold, above or below which the indicator is evaluated differently. Often requires a value judgment to be made in relation to the threshold.
Variables	Generally used to describe tangible characteristics on which individual, farmers and farms vary.

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