Australian Government

SOCIOECONOMIC INDICATORS

for natural resource management

NLWRA Project A1.2 abare **eReport** 04.19

Capacity to Change and Adopt Sustainable Management Practices in Australian Agriculture

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November 2004

Prepared for

National Land & Water Resources Audit

An Initiative of the Natural Heritage Trust

abare

ISSN 1447-817X
ISBN 1 920925 22 8

Nelson, R. 2004, *Socioeconomic Indicators for Natural Resource Management: Capacity to Change and Adopt Sustainable Management Practices in Australian Agriculture (NLWRA Project A1.2),* ABARE *e*Report 04.19 Prepared for the National Land and Water Resources Audit, Canberra, November.

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ABARE project 2981

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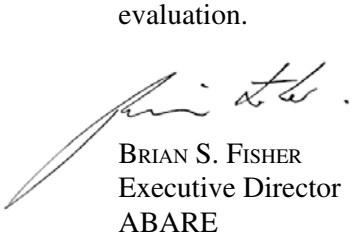
This project was managed by Karen Cody, Social and Economic Information Coordinator, National Land and Water Resources Audit under funding from the National Heritage Trust. Contact details: karen.cody@nlwra.gov.au.

foreword

The National Land and Water Resources Audit (NLWRA) has been tasked with identifying and collating data and information to provide a sound basis for reporting on the natural resource management indicators developed by the Natural Resource Management Ministerial Council's Monitoring and Evaluation Working Group. To date, work in this area has focused on identifying indicators and collating information on the long term biophysical outcomes of natural resource management programs. It is widely acknowledged that it is also important to monitor the short and intermediate term socioeconomic processes behind biophysical outcomes. This would enable program managers to:

- link their strategies to the achievement of longer term biophysical outcomes and
- design appropriate interventions by taking into account the socioeconomic factors that affect the achievement of biophysical outcomes.

In this current project, the NLWRA has commissioned ABARE to review socioeconomic indicators relating to agricultural land managers. The focus in the project is on indicators of the capacity and willingness of landholders to adopt sustainable farming and improved business management practices. Widely agreed principles are applied to identify currently used indicators of most relevance to program monitoring and evaluation.



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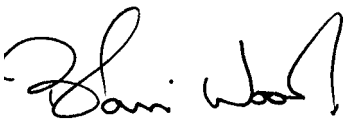

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acknowledgements

This project was funded by the National Land and Water Resources Audit, and their support and leadership in this field of research is gratefully acknowledged. Karen Cody provided valuable leadership and guidance for this project. The contribution of Colin Mues to the research program to which this project belongs is gratefully acknowledged, along with his contribution to refining earlier drafts of the paper. Thanks to Peter Martin for contributing the analysis of agricultural land use in Australia. Thanks also to Trevor Webb and Ian Byron for comments on earlier drafts.

The author wishes to thank Australia's farmers, their accountants and marketing organisations for providing data through ABARE's farm surveys, and ABARE's capable team of field survey officers, who made much of the research cited in this paper possible.

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summary and recommendations

This review provides an initial stocktake of socioeconomic indicators currently used to design, monitor and evaluate Australian Government natural resource management programs such as the National Action Plan for Salinity and Water Quality, and the Natural Heritage Trust. The principles of diffusion research are used to identify the relevance of different types of indicators for understanding the adoption of sustainable farming and business management practices.

The review shows that most Australian research into socioeconomic indicators of improved natural resource management in agriculture has relied on ABARE farm survey data. Consequently, most existing research focuses on the *characteristics* of farm family households that adopt sustainable farming and business management practices. Less research has been conducted into the adoption related *attributes* of sustainable farming practices. There has been a remarkable degree of convergence in the conceptual frameworks used by competing disciplines and research institutions to develop socioeconomic indicators for natural resource management. Innovative approaches are required to turn competition into collaboration, in order to increase the synergies derived from scarce research funding.

Recommendation 1

That the principles of diffusion research be accepted as a framework capable of integrating research into the adoption of sustainable farming practices in Australian agriculture across disciplines and institutions.

Recommendation 2

That funding for future research to develop socioeconomic indicators be guided by the extent to which proposed data collection and analysis:

- addresses the decision making priorities of clearly identified decision makers, at the appropriate scale and precision;
- uses the concepts and language of diffusion research to show the value of proposed indicators to decision makers;

- can be tested in terms of ability to explain the adoption of sustainable farming and business management practices.

Recommendation 3

That flexible data collection and analysis systems be created that give decision makers the ability to specify the precision–cost tradeoff required for specific applications of socioeconomic indicators.

This could lead to the development of:

- rapid appraisal techniques for providing snapshots of indicators when required; and
- innovative data collection systems that combine face to face sample survey techniques with mail and phone surveys, and consult focus groups where appropriate.

Recommendation 4

That institutional processes be established or strengthened to coordinate the collection of national data by the Australian Bureau of Statistics and ABARE, and use national data to prioritise and integrate regional data collections for socioeconomic indicators.

introduction

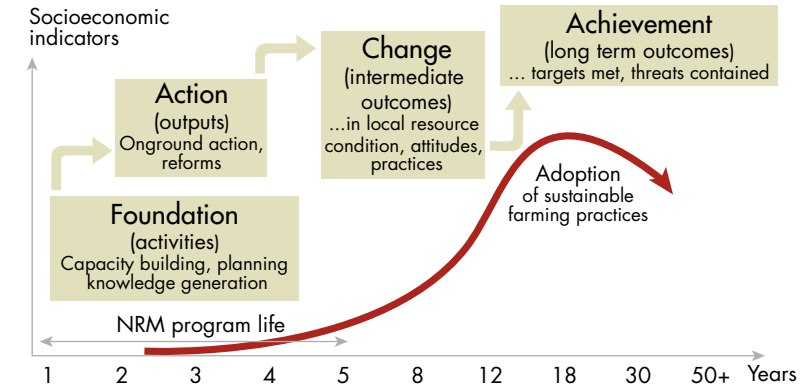
This review identifies the most policy relevant, currently collected socioeconomic indicators of enhanced natural resource management at a national scale. The principles of diffusion research are used to identify the relevance of different types of indicators for understanding the adoption of sustainable farming and business management practices. The project will list policy relevant indicators that are readily available and collected on an ongoing basis. No attempt is made to compile a comprehensive list of all possible indicators, because such a list is likely to include many indicators of low relevance to decision makers. Rather, this review provides an initial stocktake of socioeconomic indicators currently used to design, monitor and evaluate Australian Government natural resource management programs such as the National Action Plan for Salinity and Water Quality, and the Natural Heritage Trust.

The National Land and Water Resources Audit (NLWRA) has been tasked with providing a recommended set of socioeconomic indicators suited to the needs of natural resource management program monitoring and evaluation. Considerable research has been undertaken, particularly since the inception of Australian Government Landcare programs and related community movements in the early 1990s. This research originates from a range of disciplinary perspectives with diverse methodologies across different scales, and there is a need to organise this research under a common framework to highlight potential complementarities, overlaps and gaps.

Existing research into socioeconomic indicators for natural resource management has focused on the characteristics of landholders, especially broadacre farmers, that are related to the adoption of sustainable farming practices. Research at a national scale has mostly been conducted using formal face to face surveys to quantitatively estimate the relationship between broadacre farm household characteristics and the perception and responses of farmers to land degradation. Other national surveys have examined the adoption of improved business management practices across a broad range of agricultural industries. At a regional scale, mail surveys and participatory appraisal techniques have been used to analyse specific programs such as Landcare in a handful of regions. There is a need to draw these and other streams of research together to inform and enhance our understanding of the adoption of sustainable farming in Australia, and how this can be influenced by government natural resource management programs.

The initial imperative is to develop indicators to assess the impact of the Natural Heritage Trust (NHT) and the National Action Plan for Salinity and Water Quality (NAP) programs in improving the sustainability of Australian agriculture and natural resource management. The desired ultimate outcome of the research begun in this project is an integrated multidis-

A Integrating program logic with the principles of diffusion research Building on Webb et al. (2003)



ciplinary approach to monitoring the effectiveness of government natural resource management programs, nested across different scales of analysis from industry and regional levels through to communities and farm households. Some natural resource management programs have broader objectives of improving farm business management practices, and some survey instruments have been developed to provide indicators to inform this objective.

Where do the diffusion concepts of adoption and socioeconomic indicators fit within program logic? Socioeconomic indicators can be conceptualised as the missing Y axis within program logic, against which the adoption of sustainable farming practices can be analysed. This directly addresses the need for monitoring and evaluating the short and intermediate stages of program implementation (figure A).

This project is a preliminary step toward providing a set of socioeconomic indicators for the NAP and NHT. It will provide an overview of the socioeconomic indicators that have been applied in practice to study the adoption of sustainable farming practices in Australia. In doing so it will foreshadow initial steps toward integrating existing conceptual frameworks that will allow program managers and researchers from different disciplines to evaluate currently available socioeconomic indicators. A focus on tried and tested indicators at a national scale means that the project is not an exhaustive review of the rationale or all applications of all possible socioeconomic indicators. Greater emphasis is placed on indicators relevant to the adoption of sustainable farming rather than improved business management practices, because improved natural resource management is the primary objective of natural resource management programs. Specifically, the project will:

- briefly outline the key principles of diffusion research and show how it provides a widely accepted framework within which alternative disciplinary perspectives of the adoption and adaptation of sustainable farming practices by farm households can be analysed;
- provide a list of appropriate and currently available socioeconomic indicators, together with a rationale for their inclusion and where they can be sourced; and
- identify gaps in this coverage in order to recommend initial priorities for integrated research and collection of socioeconomic indicators.

principles of diffusion research

Definitions

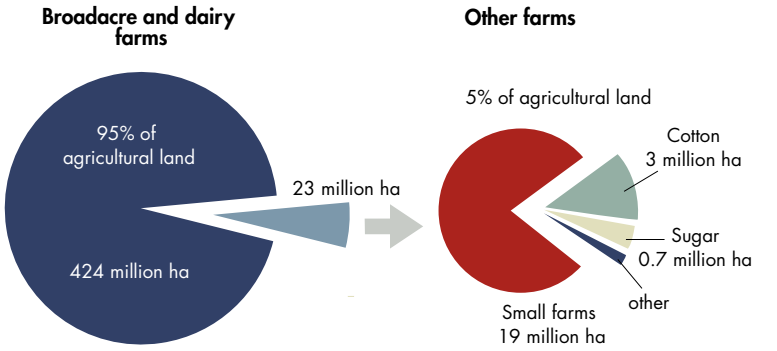
Diffusion research has been comprehensively reviewed and synthesised by Rogers (2003). Diffusion is a term used to describe the process through which an innovation is communicated to members of a social system. An innovation can be defined as an idea, practice or object perceived as new by a decision maker. Research into diffusion developed independently within a number of social science disciplines, and many of the earliest applications were by agricultural economists researching the adoption of new farming technologies. Diffusion principles have since been widely applied in agriculture, including independently to the adoption of sustainable farming practices in Australia from a variety of disciplinary perspectives (Cary et al. 2002; Nelson et al. 2004).

The adoption of innovations such as sustainable farming practices is a continual process rather than an instantaneous act (Rogers 2003). Awareness of an innovation leads to the eventual rejection, adaptation (also called reinvention) and/or implementation of an innovation to suit individual needs. Adaptation can include the iterative adoption of small components of an innovation over time, rather than discrete adoption of the whole (Cramb 2000). Trialing and subjective evaluation by peers play a major role in the process of incorporating elements of new innovations. The process of adoption (or rejection) is influenced by the characteristics of adopters, in this case farm family households, and the attributes of the innovations, in this case sustainable farming practices.

A key principle of diffusion research is that innovations are adopted by a decision making entity, whether an individual or an organisation (Rogers 2003). Through the choices of enterprise mix, intensity of farming and farming practices, farm households make decisions with both on- and off-farm natural resource management consequences. At 30 June 2002, the estimated total area of agricultural activity in Australia was 447 million hectares, representing about 58 per cent of the total land area. Broadacre and dairy farms with an estimated value of agricultural operations (EVAO) of more than $22 500 operated an aggregate area of 424 million hectares, or 95 per cent of Agricultural land in Australia, and 55 per cent of total Australian land area (figure B).

While the 23 million hectares occupied by smaller farms is only 5 per cent of total agricultural land, these farms are often located in sensitive or conspicuous environments in high rainfall, coastal and peri-urban areas. At 30 June 2002, around 19 million hectares was operated by farms with an EVAO of between $5000 and $22 500. While this area is larger than the total Australian wheat crop, it produces less than 2 per cent of the value of agri-

B Ownership of agricultural land in Australia at 30 June 2002
Australian Bureau of Statistics



cultural output, mostly in the beef industry. In addition, an estimated 0.7 million hectares is operated by sugar industry farms and 3.0 million hectares by cotton industry farms, both of critical importance to regional natural resource management. The remaining 0.3 million hectares was operated by horticultural farms, intensive livestock farms and other livestock farms, together with an estimated 1500 establishments with agricultural activity, but whose main activity was other than agriculture (for example, mining, transport etc).

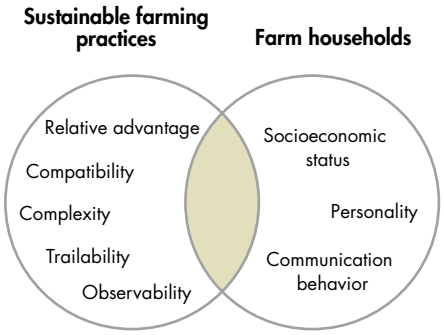
The missing piece of Australia's natural resource management puzzle is farms with an EVAO of less than $5000. These are mostly rural residential holdings, but it is likely that their aggregate land holding is significant, and probably includes many highly sensitive environments in high rainfall, coastal and peri-urban areas.

In this paper, the term farm family household is used to describe the many individual family based owners of agricultural land in Australia, regardless of industry, production or income. It is important to note that the term can have more specific definitions in other contexts, including important natural resource management programs and data collections. Some natural resource management programs focus on commercial farms, for example, while others include all landholders. In the context of ABARE's broadacre farm survey data, a much used source of data for socioeconomic indicators, it is important to note that the term refers to broadacre agricultural businesses with an expected value of agricultural operations exceeding $22 500.

What are socioeconomic indicators?

Socioeconomic indicators for natural resource management are constructs developed by researchers to measure the *attributes* of sustainable farming practices and the *characteristics* of farm family households that are related to adoption. Many of these indicators are derived through surveys with farm households, because it is the perceptions of farm households that lead to adoption. The value of individual socioeconomic indicators can be tested in terms of the extent to which each indicator explains adoption (Fenton et al. 2000, and most recently in Australia by Nelson et al. 2004 and Hodges et al. 2004).

C Sustainable farm practice attributes and farm household characteristics



Influencing the adoption of sustainable farming practices is about increasing the overlap between the attributes of practices and characteristics of households that are favorable to adoption in specific contexts (derived from Rogers 2003)

The principles of diffusion research comprehensively reviewed by Rogers (2003) provide a useful framework for identifying socioeconomic indicators to design, monitor and evaluate natural resource management programs. To influence adoption, government programs need to increase the overlap between sustainable farming practices with favorable adoption attributes and the characteristics of farm family households that facilitate adoption (figure C). The attributes of sustainable farming practices that facilitate adoption can be categorised in descending order of importance according to their relative advantage, compatibility, complexity, trialability and observability (Rogers 2003).

Diffusion research uses *innovativeness* as the key characteristic of farm family households related to adoption, defined as the relative rate at which new ideas are adopted. Innovativeness has in turn been related to socioeconomic status, personality and communication behavior.

Attributes of sustainable farming practices

The attributes of sustainable farming practices can influence the extent and rate of adoption. Socioeconomic indicators of adoption related attributes can provide insights into both past and future likely patterns of adoption for evaluating existing practices and guiding the development of new ones. Rogers (2003) has shown that the adoption related attributes of innovations can be broadly classified under the headings of relative advantage, compatibility, complexity, trialability and observability. A difficulty in applying this approach is that adoption related attributes cannot be directly measured, requiring indirect measurement through expert opinion or the construction of survey questions around each indicator.

Relative advantage

Relative advantage is the degree to which an innovation is perceived *by the adopter* as being better than the one it supersedes (Rogers 2003, p. 229). Nelson et al. (2004) further reduced the concept of relative advantage into a hierarchy of interdependent conditions necessary for the adoption of sustainable farming practices.

To be adopted by farmers, sustainable farming practices must:

- be effective in controlling degradation and/or sustaining productivity in biophysical terms such as salinity levels and crop yields;
- lead to an increase in the economic welfare of farm family households, whether in terms of financial or broader satisfaction (utility) of achieving, for example, improved environmental or intergenerational outcomes; and
- be acceptable in terms of other personal values, social norms and institutional constraints.

Compatibility

Acceptability beyond physical effectiveness and economic viability is termed compatibility by Rogers (2003). An innovation such as a sustainable farming practice can be compatible or incompatible with a farm family households' sociocultural values, previously held ideas and the felt need for the innovation.

Complexity

Complexity is the degree to which an innovation is perceived by the adopter as relatively difficult to understand and use (Rogers 2003, p. 257). According to Rogers, the perceived complexity of an innovation is generally negatively related to its rate of adoption.

Trialability

Trialability is defined by Rogers (2003, p. 258) as the degree to which an innovation can be experimented with on a limited basis. In general, innovations that are divisible and can be trialed with low cost are adopted more rapidly.

Observability

Observability is the degree to which the results of an innovation are visible to others (Rogers 2003, p. 258). Observability, for example, allows later adopters to view the results of trials on neighboring farms, complementing a tendency for decision makers to be more influenced by peers than outside experts.

Characteristics of farm family households

Diffusion research has tended to concentrate on the relative innovativeness of adopters as the key characteristic related to behavioral change (Rogers 2003). This emphasis has also been true for research into the adoption of sustainable farming practices in Australia. Research into the adoption of innovations has led to the development of classification systems for adopters based on the rate at which they adopt. Rogers (2003) synthesises the large volume of research that has accumulated into the socioeconomic, personality and communication characteristics of decision makers found to be related to adoption of innovations. These are summarised in table 1.

1 Early adopters vs later adopters

In general, across the range of contexts reviewed by Rogers (2003), which include agriculture, early adopters of innovations have been found to have the following characteristics relative to later adopters

Socioeconomic	**Personality**	**Communication**
No difference in age	Greater empathy and less dogmatic	More social participation
More formal education	Better at dealing with abstraction	More interpersonal networks and communication
More literate	Greater rationality and more intelligence	More networks outside their social system
Higher social status and incomes	More favorable attitude to change	More exposure to change agents and mass media
Greater social mobility	Better able to cope with risk	Seek information more actively
Wealthier and larger farms (more capital)	Less fatalistic, with higher aspirations	Greater knowledge and leadership

Derived from Rogers (2003).

socioeconomic indicators in Australia

Socioeconomic indicators relating to the adoption of sustainable farming practices in Australia have been comprehensively reviewed by Fenton et al. (2000) and Cary et al. (2002). Most research into the attributes of sustainable farming practices related to adoption has focused on Australia's broadacre and dairy industries, and more recently for small farms and other industries. This is because nearly all the research that has been conducted has relied heavily on ABARE's farm survey data. The broadacre and dairy industries account for over 95 per cent of Australia's agricultural land use and value of production. Because of their importance to the Australia economy, ABARE has conducted annual socioeconomic surveys of the broadacre and dairy industries since 1977-78 (ABARE 2003). Since the inception of the Landcare program in the early 1990s, ABARE's annual farm surveys have been supplemented by a triennial survey of natural resource management pressures and practices (Nelson and Mues 1993; Mues et al. 1994; Mues et al. 1998; Alexander et al. 2000; Nelson et al. 2004).

As government natural resource management programs have become more sophisticated, a number of other survey instruments have emerged that have the potential to provide national scale indicators. Some of these surveys target small farms and industries not covered by ABARE's triennial natural resource management surveys. Others target adoption of a broader range of management practices, including improved business management practices. Other developments include the incorporation of natural resource management questions in the commodity surveys conducted by the Australian Bureau of Statistics. It is unclear whether any of these surveys will be repeated, and if so, how they can be coordinated to enhance synergies.

Most of these surveys focus on the characteristics of farm family households that are related to the adoption of sustainable farming practices. There has been less research into national indicators of the adoption related attributes of improved management practices, and the adoption of improved business management practices.

Following the diffusion principles outlined above, this section provides a brief overview of research into:

- national indicators of the adoption related attributes of sustainable farming and business management practices; and
- national indicators of the adoption related characteristics of farm family households.

Attributes of sustainable farming practices

Broadacre and dairy

At a national scale, research into the adoption of sustainable farming practices in Australia has tended to focus on the extent and rate of adoption, and how adoption is related to farm household characteristics. There have been few attempts to characterise the attributes of sustainable farming practices that facilitate adoption. This is mostly because the effectiveness and relevance of specific farming practices varies with region and industry, requiring detailed participatory appraisal of local indicators. At a national scale for broadacre farming industries, both Cary et al. (2002) and CIE et al. (2001) have demonstrated the benefits of analysing the adoption related attributes of sustainable farming practices. Other work being undertaken for the NLWRA is analysing the adoption characteristics of sustainable farming practices in the dairy industry (Dairy Australia 2004).

Cary et al. (2002) ranked a list of sustainable farming practices from ABARE's 1998-99 natural resource management survey (Alexander et al. 2000), in terms of their geographic applicability, relative advantage, risk, complexity, compatibility, trialability and observability. This was a subjective expert ranking designed to demonstrate the utility of a diffusion framework for understanding the attributes of sustainable farming practices that are favorable to adoption (partially reproduced in table 2). The subjective nature of the ranking by outside experts reduces the repeatability and relevance of the indicators actually reported to the farmers likely to adopt the technologies concerned. Both these issues could be readily overcome by more detailed regional and industry surveys exploring the attributes of specific sustainable farming practices with farm family households.

CIE et al. (2001) conducted a survey with the expert members of their steering committee to rank sustainable farming practices suitable for rangelands in terms of short and long term profitability, risk, trialability, observability, capital intensity and complexity. As with Cary et al. (2002), this helped to demonstrate the utility of analysing the adoption related attributes of sustainable farming practices for Australia's rangelands. However, it was also a once-off expert assessment, reducing the repeatability and relevance of the indicators actually collected to the farmers likely to adopt the technologies concerned.

ABARE's triennial natural resource management surveys are designed to estimate the proportion of farmers adopting specific management practices in the broadacre and dairy industries (Nelson et al. 2004). These surveys provide indicators of the adoption of sustainable farming practices in response to existing land degradation, and to prevent potential future degradation (table 3). They also investigate the financial resources committed to implementing individual sustainable farming practices (table 4). The survey has been designed to explore the reasons why farmers choose to adopt or reject sustainable farming practices. However, with multiple types of land degradation and management practice in each region, there has been insufficient sample size to analyse the adoption of sustainable farm practices at a regional scale. This could be overcome by nested regional surveys examining the adoption related attributes of sustainable farming practices in specific environmental and industry contexts.

2 Characteristics of sustainable practices

Cary et al. (2002) – reproduced courtesy of Trevor Webb, BRS

Sustainable practice	Geographic applicability	Relative advantage	Risk	Complexity	Compatibility	Trialability	Observability
(Ideal rating)	*(Hi)*	*(Hi)*	*(Lo)*	*(Lo)*	*(Hi)*	*(Hi)*	*(Hi)`*
All agricultural and pastoral properties							
Maintenance of soil cover	Hi	Hi (temporal)	Lo	M–Hi (locality)	M	M	M-Lo
Establishing and monitoring ground cover targets (monitoring of pasture and vegetation condition)	Hi	M	Lo	M–Hi	M	M	M-Lo
Nutrient balance accounting (soil and plant sampling)	Lo	Lo	Lo	Hi	M	Lo	Lo
Soil and plant tissue tests to determine fertiliser needs	Lo	Lo	Lo	Hi	M	Lo	Lo
Regular soil testing	M	M	Lo	Lo	M	Lo	Lo
Fertilising of pastures	M	Hi–M (locality)	M	Lo	Hi	Hi	Hi–M
Agricultural lands treated with gypsum	M	Lo	M–Hi	Lo	Hi	M	M
Agricultural lands treated with lime	M	Lo	M–Hi	Lo	Hi	M	M
Regularly monitor water tables	M	M (locality)	Lo	Lo	Lo	Hi	M
Use of deep rooted perennial pastures	Hi	M	M–Hi	M–Hi	M (locality)	M	Lo
Noncommercial tree and shrub planting	M–Hi	Lo	Lo	Lo	M–Hi	Hi	Hi
Commercial tree and shrub planting (farm forestry)	Lo	Lo (locality)	Hi	M	Lo	Lo	Hi
Preserve, enhance areas of conservation value	M	Lo	Lo	M	Lo	M	M–Hi
Retention of vegetation along drainage lines	M	Lo	Lo	M	M–Lo	M	M–Hi
Protection of land from stock by fencing (exclude stock from degraded areas)	Lo	Lo	Lo	M	M	Hi	Hi
Protection of waterways from stock by fencing	Lo	Lo	M–Hi	Lo	M	Hi	Hi
Animal pest or weed control to control land degradation	Hi	M	M	M	M–Hi	M	M
Pest and disease control in pastures	M	M–Hi (locality)	M	M	M–Hi	M–Lo	M
Use of integrated pest management (reducing pesticide use)	Lo	M–Lo	M–Hi	Hi	M	M–Lo	M–Lo
Slashing and burning of pastures	Lo	M–Lo	M	Lo	M	Hi–M	Hi
Cropping farms							
Use of reduced or zero tillage (minimum tillage)	Hi	M	M	M	M–Hi	Hi	M
Stubble or pasture retention in ploughing (direct drilling)	M	M	M–Hi	M–Hi	M	Hi–M	M
Use of crop or pasture legumes in rotations	Hi	M–Hi	M–Lo	M–Lo	M–Hi	M	M–Lo
Use of contour banks in cropland	M	M–Lo	M–Lo	M–Hi	M–Lo	M–Lo	M–Hi
Strip cropping	M						
Adjusting crop sequences in response to seasonal conditions	Hi	M–Hi	M	M	M–Lo	M–Lo	Lo
Automated irrigation	M	M–Lo	M–Hi	Hi	M–Lo	Lo	Hi

3 Adoption of sustainable management practices by broadacre and dairy farmers
for farms where each practice was relevant **a**

	%	rse
All farms		
– tree/shrub establishment and maintenance	60	(3)
– preserve or enhance areas of conservation value	50	(4)
– formal monitoring of pasture/vegetation condition	25	(7)
– maintain vegetative cover along drainage lines	66	(3)
– exclude stock from areas affected by land degradation	53	(4)
– other practices to control/prevent land and water degradation	8	(16)
Farms in the wheat–sheep and high rainfall zones		
– soil or plant tissue tests	65	(4)
– regularly monitor watertables	21	(10)
– incorporate crop or pasture legumes into rotation	59	(4)
– dryland cropping using contour banks	25	(8)
– strip cropping	5	(23)
– use of deep rooted perennial pasture species	45	(6)
Farms with cropping b		
– direct drilling	40	(5)
– minimum tillage	32	(7)
– traditional cultivation	52	(4)
– other	3	(23)
Irrigation farms		
– laser graded irrigation layout	47	(8)
– capacity to store and reuse drainage water	40	(7)
– use of irrigation scheduling tools	8	(28)
– automated irrigation system	11	(24)
Pastoral zone farms		
– headworks to control water flow from artesian bores	55	(12)
– piped bore water supplies for stock	72	(8)
– pitting and opposed disc ploughing to promote soil conservation or revegetation	9	(30)
– controlling grazing pressure by excluding access to water	28	(21)
Dairy farms		
– soil or plant tissue test	76	(4)
– regularly monitor watertables	21	(16)
– collection of effluent in a one pond system	33	(13)
– collection of effluent in a two or more pond system	28	(12)
– collection of effluent in drainage sumps	27	(14)
– other collection of effluent	11	(25)
– pump effluent onto pasture	59	(6)
– collection of paddock water runoff in drainage/reuse system	30	(9)

a Applicable to the farmers location, enterprise mix or situation. **b** This can add to more than 100 per cent because more than one type of cultivation method can be used on a farm.

4 Average expenditure by farmers on land care related works in 2001-02

		Cropping specialists		Mixed livestock –croppers		Sheep specialists		Beef specialists	
Average land care related expenditure across all farms:									
– management control of animal pests or weeds	$	699	(24)	1 365	(30)	1 052	(43)	1 414	(21)
– land care related earthworks	$	1 546	(23)	1 295	(36)	246	(35)	379	(33)
– land care related fencing	$	462	(24)	763	(20)	1 464	(27)	598	(33)
– tree and shrub establishment	$	427	(36)	415	(29)	274	(24)	147	(37)
– changes to irrigation systems	$	47	(57)	107	(67)	137	(80)	0	–
Proportion of farms that spent money on the following land care related purpose:									
– management control of animal pests or weeds	%	35	(10)	45	(11)	37	(13)	50	(10)
– land care related earthworks	%	14	(18)	21	(17)	7	(33)	13	(26)
– land care related fencing	%	13	(20)	24	(14)	23	(21)	20	(22)
– tree and shrub establishment	%	16	(17)	19	(14)	24	(22)	13	(24)
– changes to irrigation systems	%	1	(55)	1	(59)	1	(74)	0	–

		Sheep–beef		Dairy		All farms	
Average land care related expenditure across all farms:							
– management control of animal pests or weeds	$	1 510	(23)	409	(15)	1 085	(13)
– land care related earthworks	$	455	(33)	1 604	(21)	937	(14)
– land care related fencing	$	1 467	(69)	283	(24)	776	(17)
– tree and shrub establishment	$	491	(36)	134	(23)	301	(19)
– changes to irrigation systems	$	0	(73)	415	(77)	113	(48)
Proportion of farms that spent money on the following land care related purpose:							
– management control of animal pests or weeds	%	57	(12)	32	(10)	42	(5)
– land care related earthworks	%	16	(29)	21	(15)	15	(9)
– land care related fencing	%	18	(37)	12	(20)	19	(9)
– tree and shrub establishment	%	19	(31)	20	(14)	18	(8)
– changes to irrigation systems	%	0	(73)	1	(56)	1	(31)

Note: Figures in parentheses are relative standard errors.

Small farms and other industries

As discussed above, most existing research into the attributes of sustainable farming practices relates to the broadacre grain, sheep and beef industries and the dairy industries, for farms with an EVAO of greater than $22 500. Because these industries dominate Australian agriculture, they have attracted significant research investment, including ABARE's farm surveys. There has been much less data collection and research on the attributes of sustainable farming practices for smaller farms, and other industries such as cotton and sugar.

Recent ABS agricultural surveys have included questions on sustainable farming practices relating to tree and shrub establishment and involvement in government natural resource management programs. The ABS has also trialed natural resource management related

surveys including the *Land Management and Salinity Survey 2002, and the Water Survey – Agriculture Year ended 30 June 2003*. These latter two surveys explored the nature and extent of adoption from the perspective of farmers, but did not include participation in government natural resource management programs, restricting the ability of programs to examine the association between participation in major programs and the adoption of specific management practices. A potential advantage of using ABS surveys to collect natural resource management related data is their greater sampling intensity at a regional level compared with ABARE surveys. Key disadvantages are their current irregularity, and lack of socioeconomic data for relating adoption to the characteristics of farm family households.

A recent survey by ABARE examined the adoption of sustainable farming practices for small farms and other industries with an EVAO of between $5000 and $22 500 (Hodges et al. 2004). This survey enabled the adoption of sustainable farming practices to be related to a subset of farm household characteristics collected in ABARE's broadacre and dairy industry surveys. As for the triennial natural resource management survey, less attention was given to the adoption related attributes of sustainable farming practices.

Business management practices

Some government natural resource management programs have a broad set of objectives that include promoting the adoption of improved business management practices. These practices can include farm business planning, succession and transition strategies for changing or leaving industries, the use of seasonal climate forecasting and improved risk management practices, and marketing strategies.

A survey conducted by Solutions Marketing and Research in 2002 provided national indicators of the nature and extent of the adoption of a range of business management practices of interest to the AAA program. An advantage of this survey was that it covered a broader range of industries and practices than the ABARE broadacre, dairy or small farm surveys. It was also fast and of relatively low cost. Some basic socioeconomic data were collected, enabling respondents to be characterised according to their personal characteristics and industry. A disadvantage with this survey is that it was inconsistent with either ABS or ABARE data collections, is of uncertain timing, and lacks detailed socioeconomic information.

The current availability of socioeconomic indicators of the adoption related attributes of sustainable farming practices are summarised in table 5.

Characteristics of farm family households

Most research into the socioeconomic characteristics of Australian farm family households associated with the adoption of sustainable farming practices has focused on the broadacre and dairy industries, for farms with an EVAO of greater than $22 500. As discussed above, this is mainly because of the ready availability and consistency of ABARE farm survey data. Research into socioeconomic indicators derived mainly from ABARE data has been comprehensively reviewed by a number of non-ABARE authors, including Fenton et al.

5 Currently available indicators of the adoption and attributes of sustainable farming practices (SFP)

Indicators	Rationale	Sources
Adoption of sustainable farming practices (%)	Monitoring adoption, and relating to the attributes of SFP and farm family households	ABARE surveys – ongoing since 1991-92 ABS agricultural surveys (trialed 2002) ABS natural resource management surveys (trialed 2002, 2003) ABARE small farms and other industries (2001-02)
Adoption of business management practices	Monitoring adoption, and relating to the attributes of SFP and farm family households	AAA solutions survey 2002
• in response to a specific forms of land degradation	Understanding differences between SFP	None – (included in ABARE surveys, but sample too small)
• in response to significant degradation	Understanding which farmers are responding to degradation and why	ABARE surveys – ongoing since 1991-92
• general adoption of sustainable farming practices	Understanding adoption to prevent future degradation	ABARE surveys – ongoing since 1991-92
Attributes of SFP • Relative advantage • Compatibility • Complexity • Trialability • Observability	Understanding adoption Identifying practices to promote Designing improved practices	No ongoing collection

(2000), Haberkorn et al. (2001) and Cary et al. (2002). It has also been extensively reviewed and applied in ABARE's natural resource management surveys (Nelson and Mues 1993; Mues et al. 1994; Mues et al. 1998; Alexander et al. 2000; Nelson et al. 2004). There is significant convergence in the conceptual frameworks underpinning this research around the principles of diffusion research reviewed above.

Other surveys have been developed to provide indicators of the socioeconomic characteristics of decision makers in industries not covered by ABARE's broadacre and dairy industry surveys. These include ABARE's small farm and other industries survey, ABS's agricultural and natural resource management surveys, and the AAA survey of business management practices.

Most of the above authors have reinterpreted the classification of socioeconomic indicators into socioeconomic, personality and communication behavior (figure C) to fit the Australian context. Fenton et al. (2000) proposed a classification of individual, institutional and appraisal indicators, while Nelson et al. (2004) used a classification of farm, personal and program participation indicators. Despite the contextual changes, the rationale is similar,

with farm indicators picking up on the socioeconomic influences such as farm income, size and wealth (for example, debt–equity ratio). Attitudinal questions are used to derive indicators of personality traits relating to adoption, while program participation indicators focus on communication behavior of particular interest for program monitoring and evaluation.

Broadacre and dairy industries

A list of currently available socioeconomic indicators for the broadacre and dairy industries is presented in table 6, drawing on Fenton et al. (2000), Haberkorn et al. (2001), Cary et al. (2002) and Nelson et al. (2004). Protocols have been agreed for listing biophysical indicators for natural resource management programs such as the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality (www.nrm.gov.au/monitoring/indicators/index.html). For each indicator, these require:

- definition
- rationale
- monitoring methods
- reporting products
- proposed responsibilities
- links to other indicators
- further information and a glossary.

As described above, most of the socioeconomic indicators currently used in Australia's broadacre and dairy industries are directly or indirectly derived from ABARE's natural resource management surveys. For example, of the 22 indicators listed by Fenton et al. (2000), 20 were drawn from ABARE survey data with two social indicators derived from the ABS population and housing census. Similarly, most of the indicators mapped by Haberkorn et al. (2001) and Cary et al. (2002) were also either taken directly or derived from ABARE surveys. This means that the monitoring methods, reporting products and proposed responsibilities are ABARE's triennial natural resource management survey, the ABARE and other reports presenting the data cited above, and the data package provided on ABARE's website (www.abareconomics.com/ame/lrm2/lrmalt.asp). Consequently, table 6 is reduced to the definition and rationale for each indicator for convenience.

Indicators derived from ABARE's survey data are also the most rigorously tested by both ABARE and other research groups in terms of explaining adoption (Miller and Andrews 1993; Mues et al. 1998; Cary et al. 2002; Nelson et al. 2004). Most recently, Nelson et al. (2004) used classification tree analysis to show that the most important influences on the adoption of sustainable farming practices in Australia at a national level include participation in natural resource management programs, and economic factors such as farm size, off-farm income and levels of farm equity. Other institutional and personal characteristics such as farm ownership, attitudes to change, planning horizons and age were not found to be as important as expected beforehand. This is not to suggest that these and other indicators would not explain adoption in specific local contexts, and further testing at a regional scale is required.

A number of studies have explored the use of demographic data from the ABS population and housing census to explain adoption (Fenton et al. 2000; Cary et al. 2002). At best, these indicators are contextual and difficult to relate to farm family decisions to adopt sustainable

farming practices. Rigorous testing of the explanatory power of these indicators is required before resources are committed to repeating these analyses.

ABS's recent natural resource management surveys on issues such as water and salinity management have focused mainly on the extent and rate of adoption, with questions on program participation and sources of natural resource management advice. There is little or no socioeconomic data from these surveys that can be used to explore the adoption related characteristics of farm family households.

Small farms and other industries

In 2004 ABARE conducted a natural resource management survey similar to that reported by Nelson et al. (2004) for small farms and other industries (Hodges et al. 2004). This survey covered nonbroadacre farms of all sizes, including farms in the cotton and sugar industries, as well as broadacre farms with an EVAO of between $5000 and $22 500. Awareness and management of land degradation were related to a subset of farm business and household characteristics including industry, production, marketing, education, sources of income, and program participation.

ABS agricultural surveys are designed to provide data on agricultural production. Key advantages of these surveys is that they have a much higher sample intensity and cover a broader range of industries than ABARE's broadacre or dairy industry surveys. The key disadvantage is a narrow focus on production, with little other socioeconomic data collected.

The recent inclusion of questions relating to natural resource management program participation in ABS agricultural surveys will enable testing of whether program participation helps to explain the production characteristics of farms. Further modification of these surveys would be required to relate production characteristics to the adoption of sustainable farming or business management practices. There is also a question mark over continued support for these surveys, and whether similar information could be collected by expanding existing ABARE surveys.

Business management practices

The Solutions Marketing and Research survey for the AAA program related adoption of improved management practices to personal characteristics such as age, education and attitudes to change, continuous learning, program awareness, and participation in community groups. The survey also collected summary socioeconomic indicators such as gross income shares from alternative agricultural enterprises, total crop areas and livestock numbers. An advantage of the survey was that it provided a rapid snapshot of a broad range of management practices across a broad range of industries. It is unclear, however, whether the accuracy, repeatability or reliability of this survey is sufficient for program monitoring and evaluation over time.

6 Socioeconomic indicators of farm family households available from ABARE's triennial natural resource management surveys

Farm	Rationale
Farm type	
• State and agricultural zone	Social, economic and biophysical context
• Industry classification	Type of farm, enterprise mix
• Area operated	Size, related to wealth
• Farm family labor	Human capital
• Reported significant degradation	Relevance of adoption
• Farming intensity	Vulnerability to degradation, measure of wealth
• Remoteness	Communication opportunities
Financial	
• Farm equity ratio	Objective measure of wealth
• Farm cash income	Objective measure of liquidity
• Non-farm income	
• Reported having inadequate financial resources to address degradation	Subjective measure of financial resources
• Diversity of income sources	Measure of resilience and vulnerability
Management	
• Engaged a consultant in past two years	Measure of innovation
• Have a farm plan	
• Comprehensiveness of farm plan	Measure of innovation, management skill
Personal	
Age	
Education	
• Five or more years of high school, university or trade apprenticeship	Attitude to change, innovation
• Participated in university/TAFE course in past two years	
• Informal education and training	
Attitude to change	
• Expect to be retired or semiretired within five years	Planning horizon, attitude to risk
• Reported that changing the way things are done on farm would be taking a major risk	Attitude to risk
• Reported wishing to keep the farm in the family	Planning horizon, attitude to future
• Reported farming for long term productive capacity	Planning horizon, attitude to future
Program participation	
Membership of:	
• Landcare	
• A production group	
• A production group with an NRM focus	
Participation in:	Communication behavior
• NRM programs (NHT, NAP)	
• Demonstration sites or field days in past two years	
• Conferences or workshops in past two years	

innovative data coordination

The overview presented in this report shows that there has been a remarkable convergence in the conceptual framework used by competing research institutions to develop socio-economic indicators for natural resource management. What is required now are innovative approaches to turn competition into collaboration, to reduce duplication and increase the synergies derived from scarce research funding. This requires coordination of national data collection between the ABS and ABARE, and innovative data collection methods to ensure a consistent national picture emerges from regional surveys. ABARE's triennial natural resource management survey has underpinned research into socioeconomic indicators since the early 1990s. However, it is important to understand the design limitations of this survey and not try to make it serve all purposes.

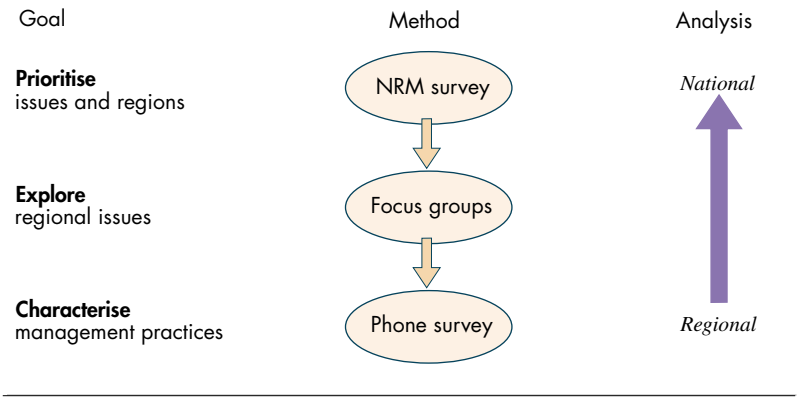
As government natural resource management programs have evolved, monitoring and evaluation have become more sophisticated, with increasing demand for regional information. ABARE's natural resource management survey is a national scale survey and works best with questions that are relatively insusceptible to multiple interpretation, or where aggregation of the results means that multiple interpretation does not matter when analysing farmers' responses. For example, participation in Landcare groups means something very similar to farmers in different industries and regions. Conversely, even though farmers in different regions and industries have different perceptions and ways of expressing and dealing with similar forms of land degradation, their responses can be aggregated to provide useful insights into the overall perceived extent of degradation.

More detailed regional analysis of the influence of government programs on the adoption of sustainable farming practices requires more specific regional surveys. Such surveys enable degradation and management specific to each region to be explored in detail, using terminology of local relevance. A tradeoff in applying regional surveys is a potential loss of compatibility with similar surveys in other regions, and with data collected for other purposes. A nested approach to data collection is required to maintain the national relevance of data collected at a regional level.

A nested survey approach would have significant advantages over current regional surveys relating to the adoption of sustainable farming practices (figure D). ABARE's national survey could be used to prioritise industries and regions reporting significant land degradation issues for more detailed regional surveys. This would lead to a more efficient allocation of resources than ad hoc methods of selecting regions for case studies.

The problem of detailed regional interpretation of reported land degradation issues and appropriate management responses could be addressed with focus groups in regions identi-

D Nested regional surveys of Landcare participation and the adoption of sustainable farming practices



fied as high priority from the national survey (figure D). These focus groups could be drawn from existing Landcare groups to ensure the relevance of the process. The purpose of the focus groups would be to select and define high priority degradation issues and appropriate management responses for more detailed investigation via phone surveys. The focus group process could also be used to identify regional differences in the expression and interpretation of generic degradation issues and management responses, and explore the concepts and processes involved in local adoption decisions.

The results of consultation with focus groups could be used to identify types of degradation and management responses for further exploration with individual farmers in the region via phone surveys (figure D). The purpose of the phone surveys would be to explore with farmers the perceived benefits of adopting specific management practices, and the disadvantages of practices that have been trialed and rejected. The concepts of diffusion research could be used to provide a framework for the survey, appropriately converted to local terminology via the focus groups. Collecting a subset of the socioeconomic data collected in ABARE's broadacre and dairy surveys would enable adoption to be related to the socioeconomic characteristics of farm households, ensuring consistency with ABARE's national natural resource management surveys.

conclusions

This brief review shows that there has been a remarkable convergence in the conceptual framework used by competing research institutions to develop socioeconomic indicators for natural resource management. The principles of diffusion research are widely accepted across the economic and social science disciplines. There is broad agreement from alternative disciplinary perspectives that understanding and influencing adoption requires indicators of the adoption related characteristics of sustainable farming practices and farm family households. The principles of diffusion research provide a useful framework for identifying the relative importance of indicators, and allocating scare research funding accordingly.

The depth and consistency of ABARE's farm and natural resource management surveys has meant that they underpin most existing national scale research into socioeconomic indicators for natural resource management. As government natural resource management programs have evolved since the early 1990s, there has been increasing demand for indicators for other industries, a broader range of business management practices, and for indicators at a regional scale. There is an urgent need to coordinate the various survey instruments that have emerged to meet these needs to ensure efficient use of scarce research funding.

Innovative approaches are required to coordinate national research into socioeconomic indicators to turn competition into collaboration, reduce duplication and increase the synergies derived from scarce research funding. There is a need to coordinate ABARE and ABS collection of national level data, and to use national level data to prioritise and integrate regional data collection. Flexible approaches such as nesting sample surveys with focus groups and phone surveys need to be considered to create opportunities for integrating research across collaborating institutions.

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Research funding. ABARE relies on financial support from external organisations to complete its research program. As at the date of this publication, the following organisations had provided financial support for ABARE's research program in 2003-04 and 2004-05. We gratefully acknowledge this assistance.

Asia Pacific Economic Cooperation Secretariat
AusAid
Australian Centre for International Agricultural Research
Australian Gas Association
Australian Greenhouse Office
Australian Quarantine and Inspection Service
Australian Wool Innovation Limited
Canegrowers
Chevron Texaco
Commonwealth Secretariat, London
CSIRO (Commonwealth Scientific and Industrial Research Organisation)
Dairy Australia
Department of Agriculture, Fisheries and Forestry
Department of Foreign Affairs and Trade
Department of Health and Ageing
Department of Industry, Tourism and Resources
Department of Natural Resources and Mines, Queensland
Department of Primary Industries, Queensland
Deutsche Bank
Fisheries Research and Development Corporation
Fisheries Resources Research Fund
Food and Agriculture Organisation of the United Nations
Forest and Wood Products Research and Development Corporation
Grains Research and Development Corporation
Grape and Wine Research and Development Corporation
Horticulture Australia
Institute of National Affairs, PNG
Land and Water Australia
Meat and Livestock Australia
Ministerial Council on Energy
Natural Heritage Trust
National Land and Water Resources Audit
National Landcare Program
National Oceans Office
New Zealand Ministry of Foreign Affairs and Trade
New Zealand Ministry of Prime Minister and Cabinet
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Office of Resource Development, Northern Territory
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Woodside Energy Ltd
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