CASE STUDIES: THEORY AND PRACTICE IN AGRICULTURAL ECONOMICS

A paper presented to the 41st Conference of the Australian Agriculture and Resource Management Economics Society, Gold Coast, 23-25 January 1997

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Abstract

Relevant research solves problems, and solving problems in present day agriculture and natural resource management increasingly involves drawing on knowledge from a range of disciplines. The mix of disciplinary knowledge appropriate to answer questions depends on the nature of the problem at hand. Research resource constraint means that there are trade-offs between the number of relevant cases which can be included in an analysis and the disciplinary breadth and depth brought to bear on each case. Thus there is a continuum of research methods from traditional agricultural economics dealing in a shallow way with large numbers of cases and drawing on a narrow range of disciplinary knowledge, focussing on a few features of each case, to the classical business management approach which typically deals with few cases and draws on a wide range of disciplinary knowledge to analyse complex systems in depth. The latter approach, commonly called the case study method, has a useful role in natural resource economics research. Attention to theoretical questions concerning design of the analysis can enhance considerably the value of the output of case studies.

Introduction

Case study methods are frequently employed across a wide range of social science disciplines including, for example, farm management, business management, marketing and psychology. Within these fields, they have long been regarded as both a legitimate and powerful way of exploring research and policy questions. For many reasons, not least the imperatives and rewards of specialisation, agricultural economists have generally favoured econometric techniques dealing with a narrow range of information covering a large number of cases relating to the issue in question. The hope is to derive some general conclusions about some aspect of a large number of cases, investigated in a narrowly disciplinary and relatively shallow way. By comparison, the case study method involves exploring fewer examples at greater depth. The aim of explanatory case studies, as distinct from exploratory and descriptive ones, is to investigate a small number of operating systems from many angles and in depth, to obtain insights into the likely impacts of changes to different but similar systems.

We would argue that once accepted as a legitimate research approach, case studies can be employed by agricultural economists to make a valuable contribution to research and policy development. The discounting of the case study method has generally taken two forms. On the one hand, case study research has commonly been seen as an 'easy' option that may be useful for teaching purposes, but otherwise inferior to surveys because of limited ability to provide substantive insights beyond the particular case. That is, there is a widely held prejudice against the apparent ability to generalise beyond single or, at best, from a limited array of cases. On the other hand, the case studies that have been carried out with appropriate disciplinary breadth and depth are generally regarded as being complicated, messy and, all things considered, simply too hard to carry out and meaningfully use. However, while there is a fair element of truth underpinning the latter viewpoint, it does not fully explain why the technique is largely ignored in agricultural economics yet widely used in other disciplines.

In this paper, we outline the nature of case studies, their strengths in comparison to other techniques, and provide some examples of the type of research for which they are most appropriate. The ability to generalise from appropriately designed case study research is also discussed, in particular the fundamental difference in generalisation from case studies (analytical generalisation) as opposed to that from statistically-based techniques (statistical generalisation).

However, in order to successfully generalise from case studies, the true nature and role of case study methods needs to be better appreciated and their conduct pursued with no less diligence and rigour than other empirical research techniques. In particular, the design phase in case study research is critical to their successful conduct, and is a topic of central concern to this paper. It is illustrated by reference to one of two case study projects that are currently being developed by the authors which are incorporated within the socio-economic component of the National Remnant Vegetation Program being jointly funded by the Land and Water Resources Research and Development Corporation and the Environment Australia Biodiversity Group. The example case study project is centred on livestock grazing management, and its effects on production and conservation performance in the grasslands and native pastures of southern New South Wales and northern Victoria. The second project (which is not discussed in this paper) has a similar focus but is located in the sub-tropical woodlands of southern sub-coastal Queensland. The project case example is used to illustrate the various phases in the case study design process, from theoretical specification of the issues to developing tests for validity and reliability.

Issues in choosing a method for our projects

The policy problem

The extensive grasslands and woodlands of Australia have major degradation problems which are of concern from both a production and a conservation viewpoint (e.g. Tothill and Gillies 1992, Department of Environment, Sport and Territories 1996). The problems vary from region to region. While from an economist's viewpoint, there may be insufficient precision about the extent and location of the problems, the scientific community and policy-makers are in general agreement of a need to address this problem with some urgency. To this end, some major programs are now in place in an attempt to address the problems (e.g. Land and Water Resources R&D Corporation Remnant Native Vegetation Program, Environment Australia Biodiversity Group "Save The Bush" Program). From a general production viewpoint, the major problems involve loss of vegetative cover (especially from perennial grass species), soil organic content and physical structure decline, and other elements contributing to nutrient and water cycling, as well as intrusive problems such as salinity, acidification and erosion (e.g. McIntyre and McIvor 1996). From a conservation viewpoint, there are relatively few grasslands and woodlands that can still be characterised as natural ecosystems, and those that remain have a conservation significance well beyond their size. These remaining areas are subject to many influences (e.g. clearing, weed invasion, over-grazing) which will lead to their loss or to irreversible degradation. Grassy woodland ecosystems are under-represented in formal reserve systems (e.g. national parks, conservation areas), and this situation is unlikely to be redressed (financially, politically) within the foreseeable future. Moreover, there is a genuine doubt concerning the effectiveness of attempting to preserve such representative ecosystems within a formal reserve system anyway (e.g. McIntyre 1994).

The policy problem arises because bio-physical, social and economic aspects are inter-related (e.g. Harrington, Wilson and Young 1984). The consequences are manifest in bio-physical terms but also in effects on farming practices and farm viability. The causes are primarily socio-economic in character but, once set in train, the changes in bio-physical processes take on a life of their own. The solutions will depend on scientific research, but the possible outcomes, how they are to be achieved and the pace of achieving them will be greatly influenced by socio-economic factors and the action of many individual land resource managers. To really understand the likely impact of new technologies, policy initiatives and/or external developments (e.g. climatic change, market changes, trade developments) on patterns of resource use that may impact on conservation values, the decision-making processes of individuals and the rich context within which this occurs needs to be better understood. One issue or barrier to real progress, however, remains the belief (rationally grounded or otherwise) that community conservation objectives are necessarily in conflict with production objectives of both individual land managers, if not the community itself (e.g. Department of Environment, Sport and Territories 1996). Despite the obvious resource management and policy implications, the underlying reasons for this perceived conflict remains largely un-researched.

Some important considerations for resource management research.

In addressing land resource management problems, issues of scale are important, from the viewpoint of both ecology and economics (e.g. Harrington, Wilson and Young 1984, Brown and MacLeod 1996). Farmer decisions about either exploiting or conserving remnant vegetation are typically made at the whole farm enterprise level. However, most agricultural R&D (including agricultural economics assessment of trial data) is conducted at smaller scales (e.g. plots, land classes and occasionally paddocks) and, thereby, fails to address the context within which such decisions are typically made. Extension of the results of such R&D are, non-surprisingly, typically pitched at the same inappropriate scales exacerbating technology transfer failure problems (MacLeod and Taylor 1995). To successfully address problems in land use decision-making, an obvious starting point is to get the scale right. We would argue that this implies a detailed understanding of the whole property resource structure, management (technological) systems and the socio-economic context of the managers (e.g. age, dependants, interest, affordability, beliefs). Addressing these issues are, in turn, believed to hold the key to improving adoption of sustainable grazing management (e.g. MacLeod and Taylor 1995).

A research method which supports the concept of exploring both underlying processes and context is clearly required (e.g. Pettigrew 1985). Conservation management research will ideally seek to combine cross-sectional (what's happening now across a range of cases) and longitudinal (is it stable over time) elements. This is because the context for conservation on farms is unlikely to be uniform or static over time or space. For example, a farmer may base a given decision on present levels of wealth, current prices, policies or understanding of the government of the day. As these variables can readily change, so does the decision context and, therefore, the likely decisions made and their consequent outcomes. Studies which effectively address these changes are important.

The key questions concerning management and the context within which the technical parameters of management are laid down must be included in these studies. For example, preferences, attitudes, social mores, opportunity values for farm labour and natural or manufactured resource endowments that underpin much decision-making. These are commonly ignored or assumed away in technical efficiency studies, which increasingly underpin a re-emerging interest in benchmarking and best practice in land resource management (e.g. Clark and Filet 1994).

The management of remnant native vegetation will largely depend on farm-family goals. Farmers have fairly complex choice functions (e.g. Cox and Ridge 1997, Dunn *et al.* 1996), which are not open to simple study or assumptions of rationality (e.g. profit maximisation). Identifying policy solutions to remnant vegetation conservation requires that these complex choice functions be addressed. Social research has a role here, but these projects also require an economic approach that is capable of providing managerially meaningful results. In order to more fully understand the nature of decision-making processes or the impact of different policy initiatives on such processes, these projects need to go beyond "what" questions, or the two logical derivatives of "how many" and "how much" (Yin 1989) (e.g. ABARE LandCare questions). Research methods which can address the more interesting "why" and "how" questions of conservation management are needed.

R&D projects addressing land resource management issues now typically seek to include an extension component. For example, all of the major industry funding agencies presently require a formal statement of how candidate projects will be structured to increase the likelihood of effective adoption of the results. A problem remains, however, that conservation management R&D is notorious for generating failed expectations about effective action on the ground by significant numbers of decision-makers (e.g. Pampel and Van Es 1977, Vanclay and Lawrence 1995, MacLeod 1997, MacLeod and Shulman 1994, 1996, MacLeod, Shulman and Taylor 1996). Rather than agricultural economics simply vacating the field, we believe that it is necessary to develop and employ research methods which will ensure that the otherwise important insights of economics are actually useful, as indicated by wide adoption.

The nature of case studies

What are case studies?

Case studies and the case study method have traditionally been hard to explore because of the limited theoretical and applied treatments they have received in the past. Generally, the specialised textbooks on experimental methods and design have either ignored the method or confused it with a topic or field to which they have been applied (e.g. ethnography). A key failing has been to critically define the technical features of case study strategies that specifically distinguish them from other research strategies (e.g. surveys, histories, experiments). Were these technical features better understood, then the role and power of carefully conducted case study research would be better appreciated and, hopefully, utilised.

This deficiency has partially been redressed, in recent times, through (amongst others) the efforts of Robert Yin, a leading scholar in the domain of case study research theory and practice in the social sciences (e.g. Yin 1981a, 1981b, 1983, 1989, 1993). Yin (1989) has argued that much of the "bad press" enjoyed by case study methods typically stems from poor definition of case studies as a *research strategy*. Through his writing, teaching and research, he has sought to provide a clear definition of case study methods, clarify their role and appropriateness within the potential array of empirical strategies for addressing research questions, and promote rigour and discipline into their conduct.

Yin (1981a) provides a technical definition of a case study as an empirical inquiry that:

(a) investigates a *contemporary* phenomenon within its real-life *context*; when

(b) the *boundaries* between the phenomenon and context are not clearly evident; and in which

(c) *multiple* sources of evidence are used.

The italics are our own emphasis. Management of remnant vegetation is a contemporary phenomenon within a farming context and is, therefore, subject to many and various influences (e.g. price levels, availability of feed on other parts of the farm, available family labour etc.). The boundary between management of a tract of remnant vegetation (phenomenon) and the whole farm (context) is often difficult to distinguish. For example, while an examination of typical farm records may provide useful information on stocking intensities and a limited array of practices on different parts of a property, they are rarely collected at a resolution sufficient to distinguish revenues and costs attributable to each part of the enterprise on which rational assessments on resource allocation between conservation and production might be based. Moreover, the majority of landholders may not place much significance on remnant or native vegetation, simply seeing it as part of the total bundle of resources with which to make land use decisions. Finally, the combination of phenomenon and context are unique on each farm and, more widely, for each resource use decision problem confronting resource managers and policy makers.

Other research approaches typically handle contemporaneous data and phenomenon-context relationships with limited efficacy or efficiency. For example, classic experimental procedure is to divorce phenomena from context through "controlled" environmental conditions. While traditional survey methods arguably might be employed to explore both phenomenon and context, they typically seek to limit the number of variables canvassed. This, however, limits their insights into context, which may be critical to the research question being explored.

An important distinction needs to be made between case study methods and the general domain of qualitative research. Part of the perception of case study methods being "soft" lies in the mistaken categorisation of the method within the more general domain of qualitative as opposed to quantitative research. Without wishing to denigrate the use of qualitative research methods, which can generate powerful insights into resource use decision-making processes (e.g. Pettigrew 1985, Patton 1990), the "qualitative-quantitative" delineation has little bearing on choice of empirical research approach (Yin 1989). Case studies can be conducted entirely on the basis of quantitative data collection and analytical techniques. Therefore, while case studies frequently rely on the collection and analysis of qualitative data, this is not a necessary characteristic of the method.

Beyond their research role, case studies are a vehicle that can be readily used for the dissemination of useful extension material based on agricultural economics research. In seeking to establish sustainable grazing management systems, managers appear more readily convinced by demonstrations of practical success implemented at the whole property scale (MacLeod and Taylor 1993, 1995).

Choosing between case studies and other techniques

Yin (1989), while recognising considerable overlap between the characteristics of various empirical methods, suggests that a choice between them might more rationally be made against three conditions; viz:

(a) the *type* of research question being posed;

(b) the extent of *control* a researcher has over actual *behavioural* events; and

(c) the degree of focus on *contemporary* as opposed to *historical* events.

The first condition really boils down to the simple "who, what, where, when, why and how" questions on which research is typically focused. While any of these questions can be handled by most research approaches, this is accomplished with varying degrees of efficiency. For example, "who", "what" and "where" questions might be best addressed through surveys or historical accounts. The more interesting (from our perspective) "how" and "why" questions, which are explanatory rather than exploratory or descriptive, are well addressed by case study methods. However, other methods such as formal experiments and historical accounts are also often employed to address this type of research question and so Yin (1989) suggests the second and third conditions provide the necessary discrimination.

Historical accounts are best used where there is no scope for control over or insight into contemporary events. Experiments, to be useful, require an ability to control and manipulate events in a direct, precise and systematic fashion which rarely can be accomplished beyond laboratory conditions. Yin (1989, 1993), therefore, identifies an appropriate niche for case study methods in research situations which deal with contemporary events in which behaviour of the people or systems at the centre of the research problem cannot be manipulated. This role is also supported by two investigative techniques (sources of evidence) that are of limited use to other methods - direct observation and systematic interviewing. These techniques can be usefully applied to other sources of evidence (e.g. documents, archival materials, surveys etc) to provide the multiple sources of evidence that are the third technical characteristic of case study methods (previous sub-section).

Multiple sources of evidence, and the case study method, are important in researching farming systems because they are generally acknowledged to be complex, and their performance is influenced by many purposive and *ad hoc* management decisions. This occurs within a context of many ill-defined or poorly understood feed-back loops and considerable uncertainty. Controlling such systems with an aim of defining the contribution of various factors (e.g. native grassland) is very difficult, especially in the presence of limited information about the functioning of the plant-animal interface. Dynamic processes and change are also characteristics of farming systems, and the case study method can capture the key elements of these processes in a way that other techniques either cannot or do so poorly.

Generalising from case studies - *analytical* versus *statistical* generalisation.

A substantial area of concern, confusion and criticism concerning the use of case study methods revolves around the issue of their "representativeness". That is, the ability to generalise the study findings beyond the immediate case from which they were derived. It is in this context, in particular, that the case study method has earned an image as representing a poor substitute to a well-conducted survey. However, this stems from a mistaken understanding of the method and the fundamental difference between generalising to theory (analytical generalisation) - a property shared by case studies and most experimental methods of natural sciences - and generalising to populations (statistical generalisation) - the focus of all survey and the majority of econometric methods (Yin 1989, 1993).

Continuing to see case studies within the context of "samples" is a mistake and a root cause for failure in the useful application of the method. Individual cases are not sampling units in any strict statistical sense. The correct context for generalising beyond immediate case findings is that of theory development and generalisation to theory. Similar to classic scientific experiments (whose generalisation is rarely queried), valid case study design will ideally be based on a well-grounded theory and set of propositions to be tested by the case. The findings are then generalised to that theoretical base according to the ensuing degree of support the empirical findings provide to the testable propositions. The use of testable theories and rival theories supports this process, which Yin (1989) likens to *level one inference*, which is the underlying basis of most laboratory and field experiments in the agricultural sciences. If the empirical findings support the theory, or better support a rival theory, progress is made in theory development. Case study methods are particularly important in expanding knowledge of theoretical propositions and hypotheses in those situations where (a) the context is important and (b) events cannot be manipulated as in a classic experiment (Yin 1993).

It follows that confidence would ordinarily increase as the empirical findings are also found to apply to multiple cases, consistent with the theoretical context from which the first case was drawn (i.e. analytical generalisation). In the same vein, the use of multiple case studies (like their direct analogue of multiple experiments) can enhance the analytical generalisation process through replication, especially when the empirical findings of the additional cases support a given theory while contradicting a well justified rival theory. The use of multiple cases should not be confused with increasing "representativeness" of "samples" which applies to statistical generalisation logic (*level two inference* - sample to population) - already argued to be inappropriate to case study methods.

Why the case study approach was chosen

For our work with valuation and management of remnant vegetation, the case study approach was selected because of the critical role played by issues of both process and context that underlie the central questions being addressed. That is, questions of *how* and *why* and against what *background* or within what *environment* decisions are made concerning sustainable management of native pastures within an extensively grazed grassland or grassy woodland context. Hence both projects aim to understand the farm system - what the technology is and how it fits (in the existing farm layout, the farming system, into "management" - age, interest, affordability, beliefs). The insights of this ecological and economic R&D should produce policy recommendations to promote the sustainable management of these pastures for conservation and production.

Neither a sample survey or a modelling exercise can adequately capture the essence of management, the monetary and non-monetary goals, the family income needs, the characteristics of each land type on the farm etc. A case study can do this, albeit with limited information for many aspects. The case study can also utilise a range of sources and cross-check results to ensure validity. In order to obtain a picture of feed availability, the grassland economics project will draw heavily on farmer records and memory for stock movement between paddocks over 12 months. Other sources used to double-check this will include research trial data, observations of district farmers and site inspections by agronomists. The rich insights of case studies, which involve extensive dialogue with decision-makers is argued to allow for specifying and disseminating potential solutions that are feasible both operationally and economically.

Phases of case study research - the importance of sound design

Once a problem or issue has been selected for research, all research is conducted in phases that typically, but not always, follow a general sequence of establishing a research design, collecting the data, analysing it, and reporting the findings. Case study research is no different. These phases are now considered.

Research design

Research design is the vehicle through which the data collected in any study or experiment and the conclusions are necessarily linked (Yin 1989). All empirical research is driven by some form of research design which is either explicitly stated or, at least, implicit from observation of the actual conduct of the research. In the latter case, when designs are poorly thought through (or even ignored), the quality of the research and general validity of the ensuing conclusions is open to challenge. Case study research is no exception and seems to be particularly vulnerable to problems of poor or limited formal design. Many researchers selecting a "case study approach" seem to commence data collection without adequately specifying their proposed method or giving serious consideration to the design - possibly under the belief that case studies are an exploratory tool that precedes some more formal experiment or survey if anything "interesting" emerges (Yin 1989). This is unfortunate logic, as we are here arguing that case study methods are valid research tools in their own right and are not merely pre-experiment explorations (although they can be). Therefore, to be successfully applied, the critical design phase must be well-conducted and adequately specified (Yin 1993).

The key to establishing a good research design for case study-based research (or any research methodology for that matter) is to follow a logical process of linking data to objectives, conclusions to data and, thereby, linking objectives to conclusions. In following such a process, Yin (1989) identifies five components or elements of a case study research design that are particularly important. These are as follows:

(1) Presenting a clear and adequate specification of the theoretical issues and, from this, the propositions that underpin the study.

(2) Clearly defining the unit(s) of analysis, including possible sub-units if these are warranted

(3) Deciding on the appropriate number of cases to explore within the study.

(4) Clearly specifying the selection criteria for choosing the case studies.

(5) Choosing an appropriate and effective data collection and analysis strategy.

(6) Developing appropriate tests to ensure the validity and reliability of the approach taken in conducting the case study.

These elements are briefly outlined, and then the specific approach taken in the example native grassland case study is illustrated.

Theoretical issues and research propositions

Specifying the theoretical issues necessarily begins with a clear outline of the specific issues of concern for the proposed study. Related to this process of considering issues to address is the basic need to clarify the underlying research questions - ie. the "who, where, what, why, and how" questions addressed in a previous sub-section. It has already been suggested that case study methods ideally address "how" and "why" questions rather than the other type, and so this is a simple re-check on the basic appropriateness of adopting the case study approach. From this exposition of the issues and assurance of the efficacy of the approach, propositions can be developed which explain the situation. Rival propositions may also be developed at this stage to be explored within a study. The formal propositions can then be tested via data collection and analysis of the results.

Unit(s) of analysis

Researchers commonly fail to clearly define and/or stick to a unit of analysis that is appropriate to exploring the theoretical issue or proposition that forms the base of the research study (Yin 1989). A clear definition of the unit of analysis is necessary to place firm boundaries on the subsequent study, to develop relevant and precise hypotheses, and to guide the collection of data. Poor or imprecise definition of the unit of analysis will typically lead to results that lack rigour and/or at best are descriptive rather than explanatory (Yin 1993). An associated problem occurs where data are collected for sub-units (e.g. a paddock) and the ensuing analysis is conducted exclusively at that level, rather than being drawn together at the original unit level (e.g. the farm) for which the issue to be researched was originally identified (Yin 1989).

The unit of analysis need not relate to some specific physical entity such as an individual, group or institution. Nevertheless, some physical or personal basis is often preferred as the unit boundaries are often fairly clear. Alternative units of analysis might include a specific policy (e.g. production quotas) or how it was implemented (e.g. national or state basis), an event (e.g. severe drought or market shock) or era (e.g. pre versus post-deregulation of the finance sector). The key to determining the appropriate unit of analysis remains the research propositions that have been defined for the study (Yin 1989).

Number of cases

Unlike statistical sampling methods there is no hard and fast rule concerning the minimum number of cases to be selected for a given research project. This results from the inherent difference (noted before) between the logic of analytic and statistical generalisation. Selection of the number of cases within a case study is necessarily influenced by the purposes of the study, the research propositions that are to be tested and the level of confidence that is required in the findings. Again, the confidence being referred to here is not that represented in a statistical sense (e.g. 95%, p<0.001 etc.), but rather in the ability of the selected cases to analytically support the proposition - generalising in a theoretical sense.

Rather than thinking in numbers of cases incrementally improving the ability to generalise beyond the immediate case, it is probably more useful to think in terms of design configuration. The traditional configurations are the *single* case and *multiple* case designs which may or may not be *embedded* (Yin 1989). Canvassing the appropriateness of the various configurations is beyond our immediate purpose. However, the following general guidelines may be usefully applied (Yin 1989):

(a) *single* cases are typically useful when there is some *critical* case against which to test a well specified proposition, or where an *extreme* or *unique* case is the main focus of interest. This design might also be used as a basis for an *exploratory* study of some phenomenon - which might form the basis of a pilot for a multiple case design.

(b) *multiple* case designs are more common and are generally used to replicate findings and/or support the theoretical generalisation process. In this case they are analogous to multiple experiments designed to support or extend some theory. The aim is to construct a rich theoretical framework on the basis of the individual cases which can then be generalised to a broader theory or understanding of the phenomena of interest to the study (e.g. the process and context issues).

(c) *embedded* case studies, which may be applied to either single or multiple case designs, simply refer to instances where the theoretical propositions are best explored via multi-tiered units of analysis. For example, a study of small and large farms may still wish to further explore the implications of age or family size by selecting sub-units from both farm types according to these demographic factors.

An important issue that is related to the selection of multiple cases in a case study design is that of replication. In arguing that case study methods appropriately generalise to theory rather than to populations, Yin (1989) makes an important distinction between *literal* and *theoretical* replication. These two forms of replication are standard features of classical experimentation. Literal replication involves the selection of particular cases (experiments) on the basis that they should predict similar results. Theoretical replication, on the other hand, involves the selection of cases that might produce contrary results - but for reasons that are consistent with an underlying theoretical proposition. In this way, multiple cases which incorporate both literal and theoretical replicates can be used to extend advance theory.

Selection criteria

This is a fundamental consideration for using the method and, ultimately, successfully linking the data and conclusions to the theoretical propositions. In some cases, the choice of case is fairly obvious such as, for example, when the study seeks to explore critical, unique or extreme cases (e.g. single cases above). In other situations, the selection may be influenced by pragmatic considerations. These might include "topicality" in which particular cases stand out as having more interest or appeal. Access and feasibility are also considerations given the resource requirements typically associated with case study methods. However, an over-riding consideration must necessarily remain the direct relevance to the theoretical propositions being tested. In this regard, the requirements for appropriate selection criteria is no different to that necessary for any other form of experimental method, especially those which are centred on replication logic (Yin 1989).

Data collection and analysis strategy

A major area of downfall lies in poor prior preparation of the various activities required by the study design and commencing data collection on the case before the design and analytical procedures have been carefully worked out and "pilot" tested (on other cases or colleagues). This is not the place to list all of the requirements for effective data collection and analysis - this is provided in detail elsewhere (e.g. Yin 1989, 1993, Patton 1987, 1990). However, a word of warning is simply that case study research is not "easy" nor are all researchers "suited" by skill, ability or temperament to the method (Yin 1989). In extreme cases where the approach is valid but the principal investigator has limited skill in the method, it may be necessary to acknowledge this fact and either employ staff with the appropriate skills or study something else.

Analysis of data will be carried out independently for each case study, both relating back to the objectives and drawing out policy implications. As each additional case is completed, the results are checked to see if they replicate the findings in the previous cases. Once all cases are completed, cross-case conclusions can be drawn (Yin 1989).

Tests of validity and reliability

For any particular research design - case study or otherwise - there are essentially four basic tests of logic that might be applied to assess its quality. These are:

(a) *construct* validity - appropriate definitions and operational measures for the theoretical propositions being studied;

(b) *internal* validity - appropriateness for establishing credible causal relationships;

(c) *external* validity - convincingly specifying the domain to which the findings can be generalised; and

(d) *reliability* - ability to repeat the findings if the same methods etc are applied..

Yin (1989, 1993) has proposed the following means to incorporate these within a case study design:

Construct validity. Using several ways to measure the key variables (constructs) in the study is an important way to overcome possible problems of inaccuracy. Multiple sources of evidence are clearly needed when little information is available on some aspects of native pasture or farm management.

Internal validity. The theory must be internally consistent. This requires careful specification of the units of analysis so that the study does not slip from one unit to another, and use of rival theories which are tested against the collected data.

External validity. This requires "specification of theoretical relationships, from which generalisations can then be made" and is a major justification for using multiple case study designs, particularly those that are embedded.

Reliability. Formal protocols are necessary to ensure that procedures are consistent across case studies. The data upon which the analysis is based will ideally be maintained in a distinct database, independent of any analysis.

Each of these elements is now discussed as they relate to a case example from the native grasslands project.

Case example - The native grasslands project

Background to the project

The project is centred on specialist grazing properties in southern New South Wales and northern Victoria which have either some remnant native grasslands (largely on the riverine plains) or some native pasture (largely on the formerly wooded slopes, hills and tablelands). Remnant grasslands are generally recognised to hold significant conservation value because they contain both a diversity of plant species and support a range of threatened species (e.g. Plains Wanderer). Native pastures are predominantly composed of native grasses and are of particular interest for their possible role in preventing and overcoming degradation of agricultural land through salinity, acidification, erosion and soil structure decline on the poorer classes of land.

The two year project commenced in August 1996. It follows an earlier exploratory project in which farmers on 28 properties in south-eastern Australia were interviewed and some preliminary budgeting on management options for native grassland was undertaken.

The objectives of the project relate to (1) clarifying the potential economic role of native grassland, (2) identifying other factors that are important to landholders in managing native grassland, and (3) looking at appropriate policy instruments (focussing on incentives) for achieving conservation goals. Three other objectives (complementary to the first objective) are to (4) produce region-specific economic information; (5) develop decision-making methods for uncertainty; and (6) develop a decision analysis package. A final objective is to (7) assist in adoption of the study findings.

While all objectives will be addressed within the one research design, the first objective relating to quantifying the on-farm role of native grassland is used to clarify the case study research design process.

Theoretical issues and research propositions

In order to quantify the economic role of native grasslands, comparisons need to be drawn between the economic performance of present management strategies and alternative strategies. Where farmers are managing for conservation at present, the project needs to determine whether this management can continue without significant opportunity cost. Conversely, where conservation management is not occurring, the opportunity costs of changing management to accommodate conservation needs need to be estimated.

The profitability and financial feasibility of different management strategies needs to be assessed on a whole farm business basis, rather than for an investment in isolation. This level of analysis is most meaningful to farmers, and it can account for the inter-relationships between native grassland and other parts of the farm. It also gives the range of production advantages and weaknesses that have been attributed to native grassland a significance that would not apply if they were examined individually.

Effects of management changes on ecosystem functioning and the land and water resources are difficult to determine, and prior research into these is limited. It is possible to test alternative strategies as 'hypotheticals' with parameters determined through consultation with case property managers, regional stakeholders and technical specialists (e.g. conservation biology, pasture ecology, grazing systems).

Two rival propositions are to be used to guide the research.

H0: If most income is not derived from the native grasslands, farms with native grassland can meet farm-family income needs while managing native grassland within conservation constraints - provided wool prices are not very low.

H1: If most income is derived from the native grasslands, farms with native grassland cannot meet farm-family income needs while managing native grassland within conservation constraints - unless wool prices are high.

Several research questions can be derived from these statements. They are:

- What disposable surplus (net farm income, operating profit, cash flow) can farms with native grassland generate?

- How can it be explained that some farms with native grasslands can meet income needs, while others cannot?

- How can income needs be met if current levels are insufficient? Taking account of climatic and price uncertainty, can it be done by:

  (a) changing management or use of grassland areas?

  (b) other means (on other areas of the farm, or off-farm)?

- Whether income needs can be met by managing within conservation constraints, both for short-term retention of species richness, and for long-term system stability which may be required as the underpinning of the production system.

In order to clearly distinguish farms with native grassland according to ability to meet farm-family income needs, the proportion of income derived from native grassland will be set at two levels: below 50% and above 70%. Wool prices over $6.50/kg are regarded as high. Very low wool prices are regarded as under $4.00/kg.

Units of analysis

The main unit of analysis will be the farm business. This is broad enough to encompass decision choices about investment and work off-farm. Sub-units will include: the farm, the land type (e.g. introduced pasture, native grassland), and the paddock (the basis for estimating stocking on each land type). Data will be collected for each of these sub-units and some analysis will be conducted at these levels. However, the critical task is to explain the effects of different management strategies for native grassland at the farm business level.

Number of cases

The propositions are to be tested for variation in several factors. Some do not require representative selection of cases to be tested, others do. These are physical conditions and proportion of farm-family income derived from native vegetation areas. These are explained as variable 1 and 2 below, and the implications for the number of case studies are illustrated. The effect of farm size and farm management, variables 3 and 4, can be tested without selecting farms on these criteria.

Variable 1 - land type. Topography, soil type and rainfall are largely independent of human action and affect carrying capacity and management options. Case study farms will be selected for two land types - (a) riverine plains and (b) slopes, hills and tablelands. Similar results (literal replication - Yin 1989) can be expected from case studies selected in each land type, hence a minimum of two is needed to test this. Testing for differences (theoretical replication - Yin 1989) between the two land types will require a minimum of one case study in each. In fact, the project has been designed so cases are selected for two sub-regions (ensuring representation of both Victoria and New South Wales) within each of the two land types - a total of eight cases.

Variable 2 - proportion of farm-family income derived from native vegetation areas. Across sub-regions, results will be compared for case studies with similar proportions of income (low or high) derived from native vegetation areas (literal replication). Results from case studies with low and high proportions of income derived from native vegetation areas will be compared to see if the differences are explained by the hypotheses (theoretical replication). Half the cases will be selected for a low proportion and half for high.

Variable 3 - farm size. Farm size for any given physical conditions directly influences income. Farm size will not be directly tested through selection of replicates based on farm size. Instead, other data linking farm financial results to farm size will be used in conjunction with case study results to estimate the effect of farm size on capacity to manage native grassland within conservation constraints.

Variable 4 - how grassland areas are managed within the whole farm system. Management of native grasslands and their use in conjunction with other parts of the farm will vary greatly from farm to farm and is likely to have an important effect on farm income. The effect of management will be estimated by identifying alternative management options for each farm, and testing the economic and financial implications of each.

Selection criteria

Specific criteria to be used in selection of case farms which are important for this objective include:

- farms must have native grassland;

- varying proportions of farm business income derived from the native grassland areas;

- availability of information about stocking the native grassland paddocks compared to others;

- the farms should have at least one land type eg introduced pasture as well as native grassland, or have native grassland across several different soil types;

- native grassland with high conservation values should be present on some farms;

- the landholder should be interested, able to give access to records and available for interview;

- the farm should preferably, though not essentially, be linked to a native grassland research project (e.g. Community Grasses) or part of a LandCare group;

- research information should preferably, though not essentially, be available for similar grassland sites to those on the case farm.

Data collection strategy

The project will involve in-depth semi-structured interviews with landholders and possibly other family members as well as more formal collection (e.g. structured surveys, inventories etc) of extensive technical information relating to the property (eg financial records, stock and paddock records etc.).

Data requirements are illustrated in the Attachment.

In order to obtain a picture of feed availability, the grassland economics project will draw heavily on farmer records and memory for stock movement between paddocks over 12 months. Other sources used to double-check this will include research trial data, observations of district farmers and site inspections by agronomists. Data about management and stocking of paddocks will be collected from at least two of the case study farms for the previous year, and will then be collected on a continuing basis for at least another year after the initial collection. This approach will give at least two full years of data. As management of grasslands, particularly in drier regions, is greatly influenced by seasonal conditions, a longitudinal dimension to the project is important.

Analysis strategy

The following steps summarise the approach.

- Determine each land type on the case farm, and allocation of paddocks to land types;

- Estimate current stocking rate in terms of livestock months (lsm) for each land type;

- Estimate monthly carrying capacity of each land type for different levels of conservation constraint and for different seasonal conditions;

- Decide feasible management alternatives, and monthly stocking implications;

- Generate economic and financial results for each management alternative by incorporating production, cost and income into a spreadsheet;

- Test for sensitivity of key variables;

- Analyse the results for the each case farm using the criteria indicated above to determine whether the hypotheses have been confirmed for that case and to draw policy implications;

- Compare results to previous cases;

- Draw cross-case conclusions.

The following criteria is applied to interpret the findings. If the cash surplus (adjusted for yearly fluctuation) available to the family is within 90% of the required income, it will be judged "adequate". However, if it is less than 70% of the required income, it will be judged to be "inadequate". Any farm investment must meet "normal" economic and financial criteria, if it is to be regarded as superior to current management. The following measures will be used: economic (net present value, internal rate of return) and financial (cash flow, break-even period, peak debt).

Testing the design for validity and reliability

Construct validity

Where possible multiple sources of evidence will be used. Farmer opinion on stock held in each paddock and stock movements will be matched to numbers in each mob. Movements of mobs will be correlated with significant events such as shearing. Finally, such information will be correlated with farm records where available. Costs and income will be verified against other data sources such as gross margin handbooks compiled by agriculture departments. Potential stocking rate for different levels of conservation constraint will be estimated on the basis of multiple sources - botanist opinion, agronomist opinion, farmer opinion, available research data.

Each case report, and spreadsheet, will be presented so that the chain of evidence can be followed from initial data to final conclusion.

Each case report will be presented to the case farm owner and to other key informants for review.

Internal and external validity

Careful comparison of the replicates will determine whether literal replicates do in fact show like results, and whether the theoretically different replicates show differences that are consistent with the underlying theoretical propositions.

Reliability

Reliability and consistency of the study will be addressed by documenting key aspects of the study and by maintaining a data base for each case study which is independent of the case report.

Discussion/conclusion

The paper originated in the need to find a suitable method for analysing on-farm land management issues. The case study method has many advantages over other techniques. The perceived weaknesses of case studies have been addressed and shown not to be substantive, though case study research is by no means easy. The errors that are commonly made in their application have been outlined. These problems can be overcome by using a good research design, which includes a stage of theory development and application. The steps in research design were illustrated by application to the natural resources problem that lead to consideration of the case study approach in the first place.

When the multiple dimensions of the on-farm situation are considered - pasture and livestock management, business viability, farm-family livelihood, land protection, biodiversity conservation - it is clear that case studies have a big role to play in agricultural and resource economics. By implication, it should also be clear from the paper that the role of case studies in agricultural and resource economics research is by no means confined to the on-farm situation.

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Attachment

Data needs are illustrated in the following table. Kinds of data and their source are shown in each column. Text in each row shows how this data will be used for each level of analysis, and whether it is derived directly or by inference.

Data from national and regional sources will be used. However, these levels won't be units of analysis in themselves.

	National, state, regional Statistics, reports.	Farm business Farm records, interviews with farmer(s)	Farm Farm records, interviews with farmer(s)	Farm-family Interviews with family	Land type Farm maps & farmer knowledge. Inspection by botanist & agronomist	Paddock Records a knowledg
Unit of analysis Farm business		Relationship between farm and off-farm activities, income by source, debt, financial viability			Effect of changing management on farm business	
Farm	Derived prices, costs (current, forecast), profit/net income over several seasons	Profitability	Profitability by enterprise - production, purchases, sales & stock data, overheads	By inference, farming approach, farming goals	% contribution of each land type; benefits of native species	
Farm-family		Extent to which income needs are met	Extent of reliance on the farm	Income needs (age, lifecycle, lifestyle, obligations (debt, dependents, dividend payments))		
Land type	Derived externalities from land degradation data & alternative management options; claimed benefits of native species; alternative uses for grasslands (e.g. seed harvesting, utilising native fauna)				Soil type, species, agronomic characteristics, conservation status, potential stocking	By additi
Paddock						Utilisati