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Foreword

Welcome to Volume 7, Number 1 of the Extension Farming Systems Journal. This is a smaller volume than the previous issues, yet it still contains papers on a range of topics from different continents in both the Research Forum and Industry Forum Sections.

The Research Forum Section publishes outcomes of research in extension and contains papers which have been subject to a blind reviewing process by two independent reviewers. The Industry Forum Section is a forum for publishing papers on extension practice, case-studies and stories. EFS will remain an on-line journal, although hard copies can be purchased at $25 per copy plus postage.

Roy Murray-Prior
Neels Botha

Editors
The character of the Extension Farming Systems Journal

The *Extension Farming Systems Journal* is jointly published by the Australasian Farm Business Management Network (AFBMN) and the Australasia-Pacific Extension Network (APEN) with free online access to AFBMN and APEN members and others. A printed version is available to interested individuals and organisations by paid subscription. The journal is registered as satisfying the refereeing requirements for the Higher Education Research Data Collection.

Extension Farming Systems Journal is an innovative extension publication of the AFBM Network and APEN. This journal covers extension aspects of agribusiness systems. Extension Farming Systems Journal is for farmers, farmer groups, corporate agribusiness managers, professional farm business consultants, extension and development officers, academics, researchers and postgraduate students who want to help extend the available knowledge about the efficient and effective operations of farming systems in Australia. There are two formats for publication:

- Extension Farming Systems Research Forum
- Extension Farming Systems Industry Forum

Extension has many definitions but to provide guidance we will adopt that found on the Australasia Pacific Extension Network website ([http://www.apen.org.au](http://www.apen.org.au)).

**Extension Farming Systems Research Forum**

The Research Forum section of the journal will publish research into agricultural extension issues that follow a recognised disciplinary research methodology. It is targeted at professional extension practitioners and will be reviewed by the Editors and members of the Editorial Board. Two Editors are appointed and Editorial Board members are nominated by the AFBM network and APEN. The Editorial Board manages the Research Forum and the Editorial Board members have advisory, mentoring and refereeing roles. The Executive Editor manages the printing of the Journal.

**Extension Farming Systems Industry Forum**

The Industry Forum section of the journal - mainly targeted to professional farmers, agribusiness managers, farm business consultants and extension practitioners - will be reviewed by an industry panel to evaluate scholarship, readability, relevance to industry and capacity to enable change. The Industry Forum section of the Extension Farming Systems Journal will publish papers on farm business and farming systems technology highlights (typically with an extension character), outstanding farm and agribusiness case-studies and leading farmers’ stories.

**Who can access the Extension Farming Systems Journal?**

EFS Journal is published online free of charge for AFBM Network and APEN members and a wider audience. A subscription for printed copies of the journal can be ordered by contacting the Secretariat. Hard-copy issues have a cost of A$25 (+GST) per issue.

**Who can publish in Extension Farming Systems Journal?**

Extension Farming Systems Journal is for members of the AFBM Network and APEN. Anyone intending to publish a paper in Extension Farming Systems Journal who is not a member of either organisation should initially apply for membership of the AFBM Network or APEN by contacting the Administrative Assistant of AFBMNetwork at afbmnetworkexecutive@listserv.csu.edu.au or the APEN Secretariat at info@apen.org.au

Initially the Journal Editors will decide whether a paper and author meets the criteria for acceptance into the reviewing process for either the Industry or Research Forum sections. The criteria for assessing suitability will vary according to the details outlined under the Industry and Research Forum sections of the Journal.

If accepted for the Research Forum it will be sent to two members of the editorial board for review. The Editors will then decide whether to publish a paper after receiving reports from the referees. If accepted for the Industry Forum it may be sent to reviewers from the Industry Forum panel for consideration and then published if their comments are favourable.

To submit a paper for publication please send an electronic copy of your paper, edited as per Instructions to the Editor at: R.Murray-Prior@curtin.edu.au.
Pathways for innovation: influence of industry structures and producer social networks

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Abstract. This paper describes how the innovativeness of producers in primary industry can be affected by individual and social structural factors and how industry and government agencies can encourage conditions conducive to industry innovation. The NZ Ministry of Agriculture and Forestry (MAF) wanted to use the results of a review in industry adoption, adaptation and knowledge transfer, to guide the development of their own role in this area. To provide the Ministry of Agriculture and Forestry with an understanding of the factors influencing farmer behaviour, published research into influences upon innovativeness and its association with fragmented, loosely coupled and highly structured industries was reviewed. The review follows the methodology embedded in the main streams of literature associated with each approach to innovativeness, that is: adoption, adaptation and knowledge transfer. In the discussion and conclusions, these are brought together by reflecting upon the industry structures within which they are each situated. For fragmented industries with individualistic decision makers, their level of innovativeness reflects decision makers’ attitudes, norms, confidence, identity and resources. Innovation can be encouraged in fragmented industries by assisting decision makers to identify opportunities for change in their daily experiences. In loosely coupled industries, innovativeness seems to be associated with levels of social capital. Strengthening formal and informal social networks can encourage the innovativeness of loosely coupled industries. The innovativeness of highly structured industry groups is related to the degree of hierarchical and political control that the dominant coalition or core group has within an industry. Innovations by groups aligned with the core group are likely to provide incremental developments consistent with the dominant industry paradigms unless there are disruptive shocks to the industry. The key learnings that the paper highlights, are how industry structures and institutional arrangements can limit or enhance the degree of innovativeness shown by agriculturalists and growers. Innovativeness is only partly influenced by the characteristics of the innovator; it is also the result of linkages between innovators and other parts of their industries and reflects their social experience.

Keywords: innovation, adoption, institutional arrangements, industry structure.

Introduction

This paper describes results from a research project initiated by the New Zealand Ministry of Agriculture and Forestry (MAF) about the processes of adoption, adaptation and knowledge transfer within primary industries. Since 1986, MAF no longer has a role providing extension services for primary industries, but it still has some oversight on behalf of the government to ensure that these industries contribute towards “prosperous, sustainable and innovative agriculture, food and forestry and related sectors” (Ministry of Agriculture and Forestry 2007). Knowledge of the processes of adoption, adaptation and knowledge transfer is considered necessary to understand the potential role for MAF in increasing productivity among farming businesses in New Zealand.

The term ‘adoption’ is used as a way of describing a conscious decision to implement a new practice or apply a new technology (Fishbein 1980). Adoption is therefore used in this paper to describe the results of processes of decision making and behaviour change. This definition also implies that during the process, a decision maker can reject a change and seek to re-establish their previous practice or technology (Pannell et al. 2006). In this way adoption is considered a process carried out by individual decision makers operating either independently of each other or collectively when shared decisions are required (Rogers 1995).

The term ‘adaptation’ is used to describe the appropriation, customisation and application of a practice or technology to suit the collective needs of decision makers. It can be described as a process of socialisation of practices or technologies and as a reflection of the social capital within a network or community (Bijker et al. 1987).

The term ‘knowledge transfer’ is less widely reported in the literature than either adoption or adaptation, but when it is used, it is mainly considered a process operating within formally organised business structures such as commercial companies rather than loosely coupled industries or individualistic decision making (de Canio et al. 2000). Knowledge transfer is examined in this paper as it might operate within primary industries with highly interdependent decision makers.
Innovations are considered to be ‘incremental’ when producers are able to introduce them to achieve their short-term goals utilising existing skills and knowledge, and with little change to their existing production systems. In contrast, radical innovations require more immediate increases in knowledge in new areas and considerable changes to existing production systems to utilise them fully.

The paper focuses upon the issues underlying innovativeness as distinct from studying the use of specific technologies. It considers the ways that innovativeness can be grown as a capability throughout primary industries with differing degrees of relative connectedness. In particular, the paper examines whether the three different perspectives on processes associated with innovativeness (i.e. adoption, adaptation and knowledge transfer) would provide similar or different insights into the interactions between industry structure and innovativeness.

Some technologies appear to be developed and applied through individual effort influenced by personal social beliefs. The development of other technologies appears to be more reflective of an industry structure that brings together a mix of people with problem-solving and creative abilities. The study for MAF is intended to consider what is known about the influence upon these processes of farmer decision making, community dynamics and industry organisation. In the studies examining innovation some have taken a deterministic approach, regarding the availability and distribution of new technologies as the primary driver of industry growth. These studies describe innovation as a supply-chain like process, starting with idea creation, technology production, marketing and sales activities that need to be managed and coordinated to realise planned targets and goals (Moreau et al. 2001). Other studies consider innovation as a socially constructed activity that is subject to the aspirations that producers might have for exercising control over their natural and social environment to achieve greater self determination (Andrew 2003). This paper takes the latter more instrumentalist approach, in order to assist MAF in its role as a moderator in primary industry innovation rather than a direct participant.

Methods

A literature search was undertaken of published papers and books on adoption, adaptation and knowledge transfer in Pacific Rim countries with strong pastoral economies. The focus was on articles reporting empirical results because that provided information on how the concepts were being applied and what their practical (as well as theoretical) significance might be. The literature search provided the project with over 300 references to draw upon and of these; the 24 most commonly cited by the others were used in this report, along with other sources from allied studies (Parminter and Clouston 2006). This selection focussed the study on the papers considered to be the most reliable in guiding the thinking of other authors.

The literature on each topic of adoption, adaptation and knowledge transfer was initially examined independently and then the results compared across the topics in a deductive thematic approach to identify common and contrasting understanding of how they could be applied in primary industries (Boyatzis 1998; Braun and Clarke 2006).

Adoption and individualistic decision making

Understanding the processes of adoption and behaviour change by individuals is a different task to predicting the actual changes in people’s behaviour. It may be possible to predict the results of behaviour change without any actual understanding of how a behaviour was influenced. However, being able to predict behaviour change provides a way of establishing the level of understanding that has been achieved in any study (Fishbein 1980).

The qualitative studies examined in this study tend to emphasis the contribution of relationships and participatory processes to extension programmes for encouraging adoption behaviour (Guerin and Guerin 1994). In contrast, researchers in quantitative studies more commonly identify key variables associated with technology use and apply them in mathematical models predicting practice change (Flett et al. 2004). These different approaches to examining and improving extension delivery may be a reflection of the results of their respective methodologies (Parminter 2006) rather than mutually exclusive understanding of extension and both are probably important in understanding and evaluating adoption processes and designing extension delivery.

Psychological models of human behaviour describe the immediate antecedents of behaviour through which the influence of more distal and external influences upon adoption and non-adoption may be understood. Models such as the theory of reasoned action (TRA) and its more recent variants (e.g. the theory of planned behaviour; Ajzen 1991) have both used measures of
human beliefs to explain peoples’ intentions and so their behaviour (Figure 1; Eagly and Chaiken 1993; Parminter 2009).

**Figure 1. Detailed factors influencing the adoption behaviour by individual landowners**

| Personal attributes: personality, age, education, values, goals, | Behavioural Context: susceptibility/opportunity, seriousness, scale, intensity, income, business security, institutional arrangements, social network, cue to action |
| | Psychological antecedents to behaviour |
| | Habitual behaviour |
| | Motivators and Demotivators for change |
| | Adoption behaviour |

Source: loosely based upon Eagly and Chaiken (1993, p 172)

The variables in a psychological model are internal to decision makers and therefore difficult for decision makers to observe. More distant from actual adoption decisions are variables that can be generalised across a number of behaviours and that may be more easily identified by external observers (Frank 1995; Pannell et al. 2006). In a number of studies, these distant variables have included factors associated with the personal attributes of individual decision makers (Frank 1997; Guerin and Guerin 1994) such as age and education. Some studies have identified specific characteristics associated with a technology or practice that influence adoption (Flett et al. 2004; Frank 1997; Guerin and Guerin 1994). These can be costs, benefits, intellectual outlay and reliability of a technology. The behavioural context has also been shown to be important, especially in the health belief model (Strecher and Rosenstock 1996) and other more agricultural studies (Frank 1997; Kaine and Bewsell 2002).

Individualistic decision-making approaches for innovation have been associated with new production techniques such as cryptorcid lambs (Tarbotton et al. 2002) and high dry matter kiwi fruit (Parminter and Max 2004), and environmental practices such as remnant bush preservation and riparian management (Parminter 2009).

Many researchers have described the process of development and adoption of agricultural technologies as if it has been a one-step process from non-adoption to adoption or rejection. However, we know from human behaviour studies that changing previously established ways of doing things is more likely to involve several steps in a multi-stage process. Some studies have identified three stages (Frank 1995) and others six or more (Prochaska et al. 1994). A multi-stage process based upon the work of Prochaska et al, would consist of:

1. **Precontemplation.** A growing recognition that a problem or opportunity exists and needs to be taken notice of.
2. **Contemplation.** The problem is recognised and any difficulties with understanding how it might be addressed are dealt with.
3. **Preparation.** A private commitment to change has been made and this is increasingly strengthened and made public.
4. **Action.** Time, energy and resources are applied to make the required changes.
5. **Maintenance.** Performing the new behaviour becomes less of an effort and more automatic.

In practice, not every stage will be recognisable for any particular individual or technology. Incremental technologies may be developed and adopted more quickly when the thinking contained in many of the stages has been established by being associated with other previous behaviours. The development and adoption of radical technologies may be more problematic if the thinking and decision making for many stages contains a high number of challenging or novel elements (Kaine and Bewsell 2002). Sometimes people recycle through the stages, or
they may compress the stages by appearing to conflate a number of stages together. Other people may stop and start again during the different stages over extended time scales. Coercive behaviour change policies may result in people skipping behaviour change stages or reversing the sequence of some stages.

Beliefs about innovation, technology adoption and practice change are going to be influenced through information, inference and experience. In recent years, agricultural organisations have had decreasing farmer membership (Green 2005; Ross White pers. comm.) and farmers have been turning increasingly to individualistic information sources such as the internet (Botha et al. 2004).

The most effective agency interventions supporting individual change processes will address the psychological motivations for change through the different stages of change. Advocacy that presents the strengths and weaknesses as well as the net advantages of an innovation will encourage positive attitudes and strengthen self-efficacy. It will also increase perceived behavioural control and self-identity. Advocacy alone may be enough of an industry intervention for some incremental technologies. Providing a full range of learning processes will be required if support is to be available for people through all stages of behaviour change. Learning support interventions will be required in addition to advocacy in any industry strategy intended to encourage the use of radical technologies (Parminter 2009).

**Adaptation in loosely coupled industries**

Innovation in loosely coupled networks of decision makers is influenced by the strength and type of connections existing between decision makers. In loosely coupled networks, decision makers however are still able to choose for themselves the networks that they wish to participate in, the amount of time that they might be involved and the group activities with which they might wish to be involved.

One example of this type of innovation in New Zealand is community-based pest control found in some rural areas, organised by groups of landowners within rural communities. For effective possum control, these groups require the cooperation and participation of all the landowners in their area to be successful. Group members may need to approach their neighbours and ask them to “do their bit” and “not let the side down” (Parminter and Wilson 2003).

The position of producers in a number of social networks has been shown to be associated with positive attitudes towards innovativeness, increased levels of adoption and greater confidence in the value of on-going practice changes to their industry (Cook et al. 2000; Frank 1997). Additional studies (e.g. Guerin and Guerin 1994) have suggested that if technologies were outside the social norms of their social group then producers have resisted the efforts of extensionists to encourage changes. The Parliamentary Commissioner’s report (2004) on learning and education, indicated that both science and policy in New Zealand lacked connectivity with rural networks. This lack of connectivity was believed to have limited the changes required in agricultural industries to address serious natural resource issues facing the country.

The effect of social networks upon the innovative behaviour of decision makers has been related to the level of social capital that the network contained (Fleming et al. 2005). Social capital is built up by relationships of shared identity, reciprocity and trustworthiness and eroded by relationships of demand, extraction and suspicion or simple neglect. Social capital encompasses the norms and mutual responsibilities that a network has available for facilitating collective action (Falk and Kilpatrick 2000).

The power of social capital is indicated in the common expression when applying for a job that “it is not a matter of what you know but who you know” (Putnam 2000 p 20). Social capital can be strengthened through activities and interventions that increase peoples’ feelings of connectedness. This requires creating opportunities for people to spend unstructured time together, as well as time to problem-solve together. Social capital can be weakened by activities and processes that break down links between industry participants and encourage individualistic or highly coupled decision making (Putnam 200).

Social capital can have positive externalities. For example, in some rural areas residents can benefit from the activities of a Landcare group protecting an area of the local stream where there might be a swimming hole. In such examples, all the families using the swimming hole benefit, whether or not they might be contributing as active members of the Landcare group. Positive externalities from networks with high social capital include greater mutual support when members are in difficulty, cooperation to undertake joint activities, high levels of internal trust reducing transactional costs, and greater effectiveness at realising shared objectives. There can
also be negative externalities from social capital, such as sectarianism when group members hold unswervingly to particular attitudes, ethnocentrism, believing the group to be superior to others, and corruption when the dishonesty of group members has been condoned by others (Putnam 2000).

Two types of social capital identified in the literature are described as bridging and bonding. Bridging social capital is inclusive of others, it occurs when a network consists of people dissimilar to each other, it reinforces social identity and assists a group to access external capability and resources and increases radical innovativeness (Lockie et al. 1995 provides a crop example). Bonding social capital is exclusive, it mobilises solidarity and creates strong in-group loyalty, but also develops out-group antagonisms. Bonding social capital tends to be associated with incremental innovativeness (for a landcare example, Cook et al., 2000). Bonding and bridging social capital have different effects upon innovativeness and are most supportive of innovativeness when they exist in balance (Table 1).

In Table 1 if decision makers have limited social contacts into their industry, then both bridging social capital and bonding social capital will be low. In that case, decision makers are isolated from each other and their innovativeness is dependent upon their individual circumstances and is highly idiosyncratic. One example of this might be the practice by landowners providing public access across private land. It is not a practice that has wide-spread farming support (bonding capital) although there can be a desire by some landowners to meet the expectations of Fish and Game and environmental groups which have valued access across private land for their members (i.e., there is some bridging social capital).

Table 1. Influence of social capital upon innovativeness

<table>
<thead>
<tr>
<th>Bonding Social Capital</th>
<th>Bridging Social Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>idiosyncratic change</td>
<td>radical innovation</td>
</tr>
<tr>
<td>(land access)</td>
<td>(herd homes)</td>
</tr>
<tr>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>incremental innovation</td>
<td>isomorphic change</td>
</tr>
<tr>
<td>(calicivirus)</td>
<td>(zinc drenching)</td>
</tr>
</tbody>
</table>

Source: Putnam 2000; with examples

If bonding social capital is low but bridging networks are strong, decision makers in the social network will tend to be outwardly focussed and more open to new ideas and radical innovations. For example early investments by dairy farmers into 'herd homes' often tended to reflect unique sets of values about the balance between production and the environment (they have low bonding social capital). Their ideas were often acquired from cosmopolitan linkages with other social groups (high bridging social capital). For example an industry article about herd homes described their originators as “innovation and problem solving seems to be in the Pows' blood. Agriculture wasn't. Kathy Pow was a nurse, Tom was a city boy raised in Auckland but decided on a farm cadetship after holidaying on a farm” (Fox 2005).

If decision makers are in a network with strong bonding relationships but have weak bridging relationships they will tend towards innovations that maintain their existing ways of doing things. An example of this might be the acquisition, multiplication and release of rabbit calicivirus by South Island farmers. This act was strongly sanctioned by a widespread group of farmers (high bonding social capital), but resisted by farming leaders who were negotiating a formal release with policy agencies - they had some bridging social capital (Parliamentary Commissioner for the Environment 1998).

Decision makers in networks combining high bonding and bridging social capital will be innovative in ways that aligns them with changes that are going on in the overall industry, both radical and incremental. Gladys Reid has now been widely recognised within the New Zealand agricultural industry for developing a practical solution to facial eczema and in 1983 she was awarded an OBE for her contribution to agriculture. Gladys's early revelations about the preventative properties of zinc oxide were associated with non-traditional approaches to farming and were widely criticised by animal scientists and research institutes alike. Despite that, her ideas were initially taken up and used by unconventional farmers operating outside existing social norms (high bridging social capital) and eventually the practice became quite widespread.
after the benefits of drenching with zinc oxide was substantiated by agricultural industry leaders (Rennie 2006).

**Knowledge transfer in highly coupled industries**

Highly coupled industries link decision makers together in organisational structures that have strongly connected internalised relationships e.g. within a company arrangement, or have linked their external relationships formally e.g. by contracts. Vertical networks within an industry are usually established and maintained to reinforce established power relationships and decision-making routines (Le Heron et al. 2001).

The structure of relationships in a highly coupled industry has a greater influence upon productivity and profitability than the structure of loosely coupled industries (de Canio et al. 2000). An industry structure loosely coupled for encouraging innovation generally increases industry performance, increases resilience to external pressures and improves producer morale but it also may have higher overhead costs than a cost-minimisation highly coupled industry (de Canio et al. 2000). When an industry which is highly coupled does not take into account the need to reorganise industry structures as part of the introduction of radical innovations, there is likely to be an underestimate of the innovation’s contribution to reduced costs for the industry and an over-estimation of the effect of exogenous cost-shocks in the process of change for producers in the industry (de Canio et al. 2000).

Innovation decision making in highly coupled industries may vary in the amount of participation involved (Zaltman et al. 1973). Authoritative innovation decisions are usually made by a small group of people privileged with leading their industry, sometimes described in the literature as the ‘dominant coalition’. The dominant coalition may consult with others in their industry but they are still the ones that will initiate and direct the adoption process. Introducing new technologies into a highly coupled industry with authoritative decision making requires the dominant coalition to:

1. Develop an understanding of the technology
2. Be persuaded in the value of making a change towards using the technology
3. Make a decision to encourage the introduction of the technology
4. Communicate the results of the decision to others in the industry
5. Implement the decision in an industry strategy.

If a highly coupled industry wants to be more participative in encouraging innovation and change it is likely that the decisions will still be initiated by the dominant coalition but they will then involve a much larger proportion of the industry before implementation. Special interest coalitions may form during consultation to promote their ideas to others involved in the process. This means that that there can be much more political conflict and bargaining going on throughout the decision-making process itself in a highly coupled industry (Zaltman et al. 1973).

People developing incremental innovations in highly coupled industries are likely to be aligned with the “establishment” or core group in any industry. They will usually share the paradigms, beliefs and rationalities of the core group and assist their industry by helping to explain those to the wider industry (Kirton 2003; Table 2). They try and develop innovations that are ‘better’ rather than ‘different’ and so the innovations that are developed by them are likely to meet the needs of the core group and readily accepted by them. Innovations from people outside this group are more likely to viewed suspiciously. This group will feel uncomfortable with “thinking outside the square” unless there are sufficient shocks to the industry to cause the existing paradigms to be disrupted e.g. the removal of farming subsidies in the mid 1980s (Parminter et al. 2000). They may then develop more radical innovations in an effort to try and restore stability to the industry (Table 2). Outside the core group of the industry there will be a group of innovators that tend towards radical innovations (Table 2; Parminter, 2007; Kirton 2003). If constrained to work within existing industry structures and paradigms they will adopt various coping strategies to maintain their involvement in the industry. If provided with the opportunities and resources to tackle critical industry issues, possibly deep seated and probably more process than product orientated, this group will provide radical innovative solutions.

An industry has only so much capacity to innovate and change (Hammer 2001). Therefore, committing more of its resources to incremental innovation will directly restrict an industry’s ability to radically innovate and make significant changes if these should be necessary. Incremental innovations can block radical innovations by dealing with the same issues as radical innovations but without addressing its more critical elements. The resultant industry changes from a high level of investment in incremental innovation may be satisfactory in the short term, but over time those industries will find the original issues resurfacing (Hammer 2001).
Table 2. Innovative behaviour of highly coupled decision making industries

<table>
<thead>
<tr>
<th>Social Group Within the Industry</th>
<th>Incremental</th>
<th>Radical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core group</td>
<td>incremental innovations to fit existing internal paradigms</td>
<td>external shocks required to change structural stability of the industry</td>
</tr>
<tr>
<td>Outer circle</td>
<td>coping behaviour</td>
<td>radical innovations requiring interdisciplinary collaboration and external paradigms</td>
</tr>
</tbody>
</table>

Source: Parminter 2007

To encourage people within a highly coupled industry to become more innovative the industry can provide:
- Role models from outside the industry
- Identification and communication of critical industry constraints
- A mechanism for converting a novelty into the industry norm
- A rethink about the critical dimensions of the core business
- A focus upon successful implementation
- Opportunities to continue involvement with innovations as they develop.

Discussion and Conclusions

In this paper it was found that industries encouraging individualistic innovativeness will be highly aware of the operating environment of producers and the context creating opportunities for developing new technologies and the adoption of new practices.

The behaviour of decision makers in individualistic parts of an industry will be associated with their beliefs about technology characteristics, the personality of the decision makers and their behavioural context. Individuals appear to have a number of adoption stages when they are adopting a technology and each of these stages has different requirements for industry support to encourage successful behaviour change.

Industry and government agencies can encourage innovation through an individualistic pathway by segmenting producers into groups with similar behavioural "drivers" and providing them with opportunities and information to reflect upon their own production systems and their decision making and learning processes (Argyris 2003).

Loosely coupled decision makers are found in those communities and industries responsive to the collective goals of the individuals within them and where the shared net benefits have been greater than the summed individual net advantages. New Zealand and Australian producers in primary industries have typically been loosely coupled decision makers and this has suited their mainly farmer-to-farmer processes of innovation (Guerin and Guerin 1994; Le Heron et al. 2001).

Loosely coupled industry groups are dependent upon the levels of social capital to drive innovativeness. Low levels of social capital lead to increased individualistic decision making and idiosyncratic practice changes through an industry. High levels of bonding social capital encourage incremental innovations that support the status quo. High levels of bridging social capital encourage radical innovations that provide step changes that may be disruptive to established industry practices. A high level of both bonding and bridging capital leads to a balanced mix of incremental and radical innovations able to be aligned to industry priorities. The loosely coupled industry pathway for innovation can be encouraged by building upon the stimulation of the individualistic pathway with opportunities to learn from the examples of other innovative thinkers operating outside their own industry and existing realm of experience.

The innovativeness of highly coupled industry groups is dependent upon the degree of hierarchical and political control that the dominant coalition or core group has within the industry. Innovations by groups aligned with the core group are likely to provide incremental developments consistent with the dominant industry paradigms unless there are disruptive shocks to the industry. Innovation by more marginal groups in a highly coupled industry are likely to tend towards more radical innovations unless they are constrained to work within an existing industry paradigm. A highly coupled industry can encourage greater radical innovation...
by establishing multidisciplinary project teams but they have to be prepared to find such groups more difficult to manage and fund.

Highly coupled decision makers in primary industries are usually found in formally organised structures such as poultry-meat industry where the production, processing and servicing of the sector is controlled through vertical integration and contracted agreements (Cooper-Blanks 1999). Organisations in those industries have established objective decision making processes using separate internal structures for governance, management and operations. With highly coupled decision makers, producer behaviour is constrained by the policies and strategies of other parts of their organisation (Parminter et al. 2000).

The pathway for innovation in highly coupled industries can be stimulated by providing a transparent process of investment into innovations and their development. The innovation process can be used to support the generation of ideas from groups outside existing production structures and any decisions about which ideas to proceed further with or restrict left until well into their development and made by a group that includes people from outside the existing industry paradigm.

Product and service innovations have generally tended to be diffused at greater speed through an industry than process innovations. This has been due to products and services being relatively market focussed whereas process innovations have been internally focussed, especially if they were dealing with matters of efficiency. Products have been more observable and product champions have tended to be more centrally situated in an industry, therefore products have tended to be developed faster with less political interference. Products have lent themselves to being standardised for use across an industry whereas process innovations have been much more likely to be idiosyncratic and so their diffusion slower. Process innovations have usually been more disruptive, and they have been likely to affect a wider cross-section of an industry (Damanpour and Gopalakrishnan 2001).

Rather than an industry being entirely one structure or another, different parts of any industry could reflect any of the three different structures described in this paper. Different innovations will be more likely to arise and be diffused through those parts of the industry depending upon the nature of the innovation and how that relates to the connectedness of that group of producers. Considering the way that different industry structures affect innovation can assist the design of policy interventions to encourage innovation.

The challenge for primary industries and government agencies is whether to encourage innovation by supporting individualistic decision-making strategies through direct channels of communication, or to strengthen social capital by assisting networks to develop with similar producer groups and with groups that may be taking quite different approaches to industry development; or to support marginalised groups within an industry capable of radical but maybe disruptive innovations. Depending upon the industry-agency relationship a combination of these three may be possible.

Three Key Lessons:
1. Innovation is produced by social experience.
2. Industry structures and institutional arrangements can limit or enhance the degree of innovativeness shown by agriculturalists and growers.
3. Innovativeness is only partly influenced by the characteristics of the innovator, it is also the result of linkages between innovators and other parts of their industries.

Acknowledgements

The funding and support of staff at the Ministry of Agriculture and Forestry was greatly appreciated. Thank you to the referees whose suggestions assisted to clarify a number of points in the text.

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Innovations in the marketing of agricultural produce: the case of the FASO JIGI cooperative in Mali

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Abstract: Substantial numbers of smallholder co-operatives in Africa fail each year due to their inability to be self-sustaining. Liberalization of Mali’s cereal sector in the 1990s resulted in transition from a cereal deficit to self-sufficiency. However, problems like credit, poor marketing and low prices hindered real development of the sub-sector. In 1997, the FASO JIGI Cooperative marketing project, a union of cooperatives with regional coverage was set up, focusing on the collective management of cereal marketing, allowing producers a more active role, resulting in better product prices and income stabilisation. Key issues this paper addresses include members’ attributes and what they derive and contribute to its sustainability. The study involved 250 members and 27 extension officers randomly sampled and data analysed using simple cost calculations, frequencies and percentages. Members’ active involvement, good social climate, conformity and control, communication patterns, monitoring, indigenous management systems, funds generation, training and regional government support were key sustainability factors.

Keywords: cereal, credit, cooperative, farm, financing, marketing

Introduction

Grain marketing innovations in West Africa

An important constraining factor to increased agricultural productivity in Africa is “poor market access”. Many small-scale farmers who rely on agriculture for their livelihoods sell most of their farm produce to traders soon after harvest to either meet immediate cash needs or avoid high grain storage costs (Berg and Kent 1991). At this time, prices are at their lowest and the income received is barely adequate to meet the myriad needs of the households. Consequently, little or no cash is reserved for the purchase of farm inputs the next season. During the lean season when all crops have been planted and new ones are yet to be harvested, grain prices are highest and invariably rural farm households run out of grain stocks and are compelled to purchase from market traders. All the storage and financing costs absorbed by the traders are passed onto the consumers (including the farmers who are now consumers). This system compromised farmers’ livelihoods, resulting in shrinking farm sizes, diminished demand for inputs such as seed and fertilizer and thereby decreasing agricultural productivity (Coulter 2005).

Access to reliable markets, therefore, is a prerequisite for increased input demand, growth in the agricultural sector and subsequently improved rural livelihoods. The problem is how might farmers be brought closer to better markets? In most parts of Africa, market infrastructures are poorly developed. Governments lack the capital and motivation to improve road networks, warehousing, stores, grading and standards in the rural communities. This suggests that for farm households to improve their livelihoods there is the need for alternative interventions.

Market-oriented initiatives

Francophone experience: Francophone Africa has seen some of the most notable achievements with collective marketing. Starting in Mali in 1974, ‘Associations Villageoises’ (AVs) and similar producer organizations (POs) became a major component of contract-farming systems in the burgeoning parastatally-controlled cotton sectors of francophone countries. The parastatals were able to devolve much of the responsibility for input and equipment supplies and primary marketing of seed cotton down to these all-village institutions in a mutually beneficial manner. The AVs worked in a linkage dependent relationship with the parastatal cotton companies, which oversaw their operation and had a stake in their survival (Coulter and Tyler 1992; Bingen 1998).

Mali and other francophone countries have also witnessed large numbers of producer organizations (AVs and ‘groupements’) being organized in conjunction with irrigated rice schemes (DNA 2000). While often playing an important role in service provision, they have encountered many serious governance and management problems. In 2005, farmers were largely bypassing them in favour of other support mechanisms, including micro-finance institutions and moneylenders. One knowledgeable commentator (Kwadjo 2000) estimated that only 2 percent of all POs working in the zone were operating correctly; most of the others were highly indebted and technically bankrupt.
The cereal market in Mali was liberalized early in 1990. This reorganization resulted in the change from State monopoly to an active participation of the private and associative actors. The new situation led to an increase in production from most farms, thus changing the country from a cereal deficit nation to a self-sufficient nation, despite a population growth rate around 3% a year. However, despite the progress and the improved environment, several factors continued to hinder the development of the cereal sub sector (Coulter & Tyler 1992). They are mainly:

- price distortions on the market and high seasonal price variability (low price in the harvest period and high in shortage period),
- bad quality of marketed cereal,
- weak organization of actors namely producers for product marketing,
- individual cereal supply not allowing individual producers to obtain a higher price in the market,
- difficulty of access to credit by the producers.

Facing these development problems in the cereal sub sector, the Canadian cooperation and the "Programme de Restructuration du Marché Céréalier" (PRMC) initiated, in 1995, an 18 month pilot project to support the rural sector. This project focused on the collective management of cereal marketing (rice, millet and sorghum) and was known as the "Cereal Marketing Support Project in Mali" (PACCEM).

This pilot project was implemented in Segou region by a commission formed by the union of agricultural producers and international development (UPA DI) and "Développement International Desjardins" (DID). The project goal was to allow producers to play an active role in the cereal marketing sub sector, so that they could obtain better prices for their products and stabilize their income. The project purpose was to set up tools to establish a collective cereal marketing system supported by a simple and credible democratic structure able to represent member producers. The objectives of the project were to:

- Development a democratic organization of farmers, for better representation at the sub sector level.
- Train farmers as well as help them have easier access to credit and to make farmers responsible and autonomous.
- Work together with various stakeholders within the cereal marketing sub sector so as to meet the country’s reliable demand.
- Empower farmers in the marketing of their product by creating awareness on various market signals like the price, volume and quality.

**Establishment and development of FASO JIGI**

The FASO JIGI project was launched in September 1995. The first activity of the project consisted of the selection of farmer organizations (GP) through whom producers would market collectively. The selection exercise was democratically done and the selected organization was representative of all the member organizations. Previously, an organization grouping together all the Farmers Organizations within a region did not exist. The project thus had to work, in association with the Regional Board of Agriculture (CRA) of Segou, on the implementation of the Transitory Committee of Farmer Organization (BPOP). During the pilot phase, besides the numerous sessions of sensitization/training/information implemented at the grass roots level, two general assemblies were held and it was during the third assembly held in November 1996 that the rules and regulations of the organization were adopted and the organization was legally recognized as FASO JIGI.

A financial viability survey, conducted in January 1997, (18 months after launching the pilot phase) gave the green light confirming the originality of the idea as well as the merits of the intervention and its sustainability. The viability implies, on one hand that the operation is financially profitable in the medium term, on the other hand, that the organized farmer organization is able to take care and to execute all the activities connected with the collective marketing system.

Following the results of this survey, the Canadian Cooperation for Development (ACDI) agreed to finance the project’s first phase of five years from 1997 to 2003. This phase was essentially dedicated to the development of FASO JIGI in terms of membership, of the volume of the loans, the quantities of marketed cereal and also particularly in term of relations with partners.

In 2001, FASO JIGI was equipped with its first strategic plan, with its main objective as "autonomy in the organizational and financial management". To achieve this, the organization requested a second phase. Following the project and the farmer organization’s positive results,
a second phase (2003-2009), implemented by UPA DI was granted to strengthen the achievements of FASO JIGI and, eventually, make the organization autonomous.

The second phase of the project, which was launched in 2003, considered the concerns of women shallots producers as well. During this phase, FASO JIGI had its own staff and the farmer organization worked in a well-structured frame with an annual work plan as well as running and marketing budgets. FASO JIGI was financially audited every year to ensure a complete transparency, its credibility with all the partners and the respect for democracy. PACCEM’s role completely changed during the second phase. Instead of it being directly involved in the field, it acted as an adviser around five main axes:

- The consolidation of FASO JIGI achievements
- The integration of the women within FASO JIGI
- The strengthening of FASO JIGI organizational and financial level of autonomy
- The transfer of all the activities to FASO JIGI
- The achievement of a training, information and sensitization program conceived and adapted to FASO JIGI members’ needs, from the grass root to the summit.

The project actions were focused on three main areas of intervention of the ACDI namely:

- **basic human needs**, through the implementation of activities favouring higher volume of cereal production and consequently, the achievement of food security,
- **private sector development**, through the implementation of farm produce marketing structures organized by Malian farmers of both genders,
- **women and the development**, through the support brought directly to OPs of Malian women farmers, such as adult education programmes, autonomy and self-management classes to improve their incomes.

FASO JIGI has been active for over ten years in Mali and it is the intention of this paper to investigate its activities as well as assess the acceptability and viability of its farm produce marketing structures. Specifically, the paper will investigate and discuss:

- membership and benefits to members
- factors in the sustainability of FASO JIGI
- constraints to its operations.

**Literature review:**

**Cooperative, advantages and collective marketing:**

A cooperative refers to an autonomous association of persons, including natural persons, who unite voluntarily to meet their common economic and social needs through a jointly owned and democratically controlled business in terms of the Cooperative Act (91/1981)(South Africa Coop Act, 1981). The establishment of cooperatives can result in various advantages for its members. Firstly, the cooperative can supply services to its members which other suppliers are unwilling to do. Secondly, cooperatives can increase the bargaining power of individuals enabling them to obtain services and products at more favourable prices. Von Ravensburg (1999) adds that the bargaining power obtained not only contributes to the goals of individuals, but that the forming of cooperatives can also contribute to the alleviation of poverty, especially amongst the less privileged communities. The cooperative is the ideal type of business to concentrate on and contributes to the socio economic needs of its members (Bhuyan & Olson 1997). In rural communities, the cooperative can play an important role as the economic engine for creating jobs and increasing rural income. People can participate in the cooperative sector to help building a community that benefits them, as well as their neighbouring communities (Hazen, 2000). Cooperatives should actually be in a better position to contribute towards poverty alleviation because their members manage them. Any surpluses generated by their activities are available to the individual members (Von Ravensburg 1999).

**The importance of the cooperative**

However, not only individuals benefit from forming cooperatives. The small business sector often faces the same problems and can also use this type of business form to promote themselves. Since they have limited bargaining power, small businesses often pay higher prices for products, are charged higher interest rates and get limited credit facilities (Moolman, 1998). Economies of scale enable large businesses to dominate many markets, which can lead to the demise of small businesses. If small businesses can combine their flexibility and market knowledge with economies of scale, they will be able to compete with large businesses and survive competition (Masurel & Janszen 1998; Ropke 1992). The government, donors and business community can be more inclined to use the cooperative as an instrument for
channelling aid to the small business sector. This will not only contribute to the survival of the small business sector, but can also position the small business sector in a way that it can contribute considerably to the economic development of a region or the country as a whole. The cooperative as a business form actually serves as an instrument of development in the hands of the small business sector and the establishment of cooperatives by small businesses has become a worldwide trend (Hazan, 2000). The small business sector is supposed to keep communities alive. These businesses, however, find it hard to survive due to competition. Participation in cooperatives will help them to build these communities (Hazan, 2000).

**Initiatives concerned with markets, local food security and problems:**

Collective marketing schemes (CMS) are the best known POs concerned with staple foods in Sahelian countries. Thousands were organized under the auspices of NGOs and development projects in the wake of famines in the 1970s and 1980s. The objectives were to prevent farmers from ‘over-selling’ at low prices and then buying back at high prices, to avoid exploitation by middlemen and help surplus producing farmers to find a better market for their grain. In the main part they have proved institutionally unsustainable, tending to progressively decapitalize and disappear once outside support was removed. Drawing upon a range of sources (Gergely et al. 1990; Berg and Kent 1991; Günther and Mück 1995; Reusse 2002), one can attribute the poor performance to difficulties in competing with private trade in ‘spatial arbitrage’ (trading between geographic locations), frequent losses from ‘temporal arbitrage’ (speculative storage), providing credits in the lean season to members who do not repay, management errors (due to a mixture of inexperience, slow collective decision-making, and social pressures) and corruption.

Collective marketing schemes were particularly vulnerable to these problems because of the heterogeneous nature of their membership, including surplus producing members, deficit producing members and non-producers, and having objectives that cover both business and social functions. As such, CMS membership tends to lack a single-minded focus for its activity. Part of the problem should also be attributed to the promoting entities’ limited time horizon and charitable outlook. In this regard, Günther and Mück (1995) noted that the support these entities provided during a 20-year period never included an external audit. In addition, farmers at the village level often think that since it is the outsiders who identified the problem and instituted the CMS to solve it, they (outsiders) should make sure that the CMS works. Other weaknesses of CMS included: (1) lack of financial prudence due to the absence of any institutional representation on the management board, and (2) no incorporation of tools for monitoring and evaluation in the set up.

According to Coulter and Schneider (2004), Tanzania’s experience with market liberalization in the 80s and 90s provides further evidence of the relative unattractiveness of collective marketing with staple crops. Generally, private traders encroached on the cereals trade earlier than they did on the trade in cash crops such as cotton and coffee. Cooperative Unions remain significant players in the coffee sector to this day, whereas their exit from cereals started during the 1980s. At the time this was happening, donors were busily funding the construction of primary society stores under the ‘Rural Structures Programme’, with the understanding that primary societies would use these to hold surplus production. Around 1,000 stores of circa 300 tonnes capacity were eventually built, and until the early 90s, the Government of Tanzania was committed to providing such stores for the majority of villages in the country. In practice, however, farmers preferred to store their surplus grain at their homes rather than entrust it to their local primary societies, and the majority of these stores have remain unutilized to this day (Coulter and Tyler 1992).

**Success Factors for Effective Cooperatives:**

In order to have a vibrant cooperative sector, an environment conducive for cooperative development should be created and certain aspects should be addressed. The following factors play an important role in the effectiveness of cooperatives.

- **Effective management:** Cooperatives should be managed effectively. Conflict between members and management, including the board of directors, must be avoided (von Ravensburg 1998). The advantages of cooperatives will only be realised if the cooperative continues to operate as a sustainable form of business.

- **The initiative for the cooperative must come from its members:** Those who will eventually enjoy the advantages of the cooperative must initiate the establishment of the business. Therefore, a bottom-up approach should be followed. (Bhuyan & Olson 1998).

- **Member support and commitment:** The cooperative will only succeed if continuous commitment and support by its members exist. (Randall 2001). Members must realise that the cooperative basically depends on them for its existence.
Entrepreneurial mindset: A factor often ignored when addressing cooperative success is the entrepreneurial mindset of members (Röpke 1992). Environmental factors influencing the business sector also apply to cooperatives. In order to address the changing needs of members, all role players (including members, management and directors) must be creative and innovative.

Cooperative education: The cooperative form of business must be completely understood and education should also deal with business, marketing and financial issues (Haskell 2003, Campbell 2003).

Government support: Although a cooperative is member-driven, government support is indispensable. Government should provide the policy conducive to cooperative development (Von Ravensburg 1999).

Methodology:
This paper consists of secondary reports, interview schedules and questionnaires supported by qualitative interviews with 250 randomly selected members (100 members from cereal, 100 members from rice and 50 members from the shallot group) of the FASO JIGI cooperative groups. According to Duvel (1999), interviews and questionnaire methods of data collection are one of the few techniques available for the study of opinions, attitudes, importance, values, belief and motives.

Various reports were available at the secretariat of FASO JIGI in Segou (FASO JIGI Reports 2003-2008). These reports include activity reports, sales reports, financial reports and membership reports. The reports were all up to date at the time of data collection. Data collected from the activity reports included training reports, seminars and conferences organized and memorandum of understanding with other partners. Sales reports provided data on sales and revenues for over ten years while the financial reports gave information on loans and loan recovery rates. Membership reports gave the evolution of members in the scheme and their gender orientation.

The questionnaire developed for the study was divided into two parts namely: importance of FASO JIGI on members reasons for its success; and problems encountered as members of FASO JIGI. Data were analysed using simple frequencies, means, percentages and simple cost and loan repayment analysis.

Findings
Membership of FASO JIGI:
Considered as one of the strongest farmer organizations in Mali, FASO JIGI had 5 108 members grouped together in 134 cereal producing cooperatives (consisting of 71 rice cooperatives and 71 dry cereal groups), and has recently included in its membership 12 groups of women shallot producers. The initial groups that registered with the FASO JIGI scheme were the rice and dry cereal cooperative groups up till the year 2005 when the women shallot cooperative groups were absorbed because of the important quantity, quality and the demand for shallots.

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Cooperatives (#)</th>
<th>Members (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>61</td>
<td>2 364</td>
</tr>
<tr>
<td>Dry cereal</td>
<td>61</td>
<td>1 173</td>
</tr>
<tr>
<td>Shallot (exclusively women)</td>
<td>12</td>
<td>571</td>
</tr>
<tr>
<td>TOTAL</td>
<td>134</td>
<td>5 104</td>
</tr>
</tbody>
</table>

Cooperative members interviewed as to the reasons for becoming members of FASO JIGI scheme claimed that:
1. It provides better marketing services for farmers and consumers at the village level and regional level (98%);
2. Reduced post-harvest losses (100%);
3. Strengthen village-level organizational capacity (92%);
4. Creates village-level emergency food stocks (100%);
5. Ensures efficient supply of production inputs at the right time (100%).

Apart from addressing both food security and market access, FASO JIGI also attempts to deal with the issue of market traders exploiting farmers and consumers in rural settings. In many cases, they also serve as social activities in bringing buyers and sellers within the community together.


15
Factors that enhanced the sustainability of FASO JIGI cooperatives:

Organization and management of FASO JIGI:

As presented in Table 3, good management and organisation contributed to the success of the cooperative. FASO JIGI is a union of cooperatives. It possesses its rules and regulations in agreement with the law and is structured to ensure the fair representation of the areas of intervention as well as the identified cereals for the collective marketing (rice, dry cereal and shallots). The regional coverage includes Bla and Segou districts as well as the Office of Niger and specifically Macina and Niono districts.

The Organization chart plays a very important and strategic role at the board of directors’ level and the information flow from the bottom to the summit and vice versa. The general assembly consists of the supervision committee that ensures that all activities are duly implemented and reports to the board of directors. The board of directors are elected on a biannual basis from the three different professional cooperative group types namely: dry cereals groups, shallots groups and rice groups; and lastly the orientation committees from the three groups of cooperatives that help manage the business affairs of the various groups. This is in agreement with Röpke, (1992) who believed that for a cooperative to be successful, the management must have an entrepreneurial mind set. All of the members emanate from the various cooperatives registered in the FASO JIGI scheme. FASO JIGI has its own paid staff that consists of: an executive secretary, a marketing agent, an accountant, a jurist, and a store man. FASO JIGI works in a well-structured frame with an annual work plan as well as running and marketing budgets. Von Ravensburg (1998) agrees that a cooperative should be managed effectively to succeed. FASO JIGI is financially audited every year to ensure a complete transparency, its credibility with all the partners and the respect for democracy. Its annual turnover is 1.2 billion CFA francs, and its functioning is self-financed up to 65 % due to contributions from members.

Activities organised for its members

Credits to members: FASO JIGI’s collective system of marketing includes a financing program specific to the organization and is supported by a multidisciplinary team of 25 persons from the PACCEM. The financial system is based on the principles of prepayments. These prepayments include advances of income granted to producers before production and marketing of their cereals. All the members fill the inquiry form specifying their production projections and volume that they will market within their union and all members provide correct information which to a large extent shows their commitment; which is an important factor in the success of a cooperative according to Randall (2001). From these data, every member receives payments that are made in two instalments:

Table 2. Items in the sustainability of FASO JIGI by members (N= 250):

<table>
<thead>
<tr>
<th>Items</th>
<th>Rice coop. Members(%)</th>
<th>Dry cereal coop. Members (%)</th>
<th>Shallot coop. Members (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good Managerial &amp; organisational capacity</td>
<td>89</td>
<td>92</td>
<td>81</td>
</tr>
<tr>
<td>Various activities organised for members (credit, marketing, conflict resolution, purchase of farm inputs etc)</td>
<td>96</td>
<td>98</td>
<td>87</td>
</tr>
<tr>
<td>Monitoring of farming activities (quantity and quality) and cereal marketing for members</td>
<td>88</td>
<td>77</td>
<td>90</td>
</tr>
<tr>
<td>Self financing programme</td>
<td>100</td>
<td>100</td>
<td>91</td>
</tr>
<tr>
<td>Regional government support</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Commitment and support of all members and partners</td>
<td>93</td>
<td>97</td>
<td>87</td>
</tr>
<tr>
<td>Training for its members</td>
<td>90</td>
<td>93</td>
<td>67</td>
</tr>
<tr>
<td>Good environment for production and marketing</td>
<td>86</td>
<td>84</td>
<td>72</td>
</tr>
<tr>
<td>Participation and involvement of members</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Social climate</td>
<td>78</td>
<td>68</td>
<td>82</td>
</tr>
<tr>
<td>Social conformity and control</td>
<td>71</td>
<td>88</td>
<td>64</td>
</tr>
</tbody>
</table>

Source: Data collected in 2009 survey.

- The first pre-payment: represents 60% of the cereal transfer price (fixed by the Board of Directors) and is granted to producers during the first week of June of the current campaign. It is financed by the foreign partners and acquired on the 31st of December
through a credit line granted to FASO JIGI by the National Bank for Agricultural Development (BNDA). This system insures a 100% repayment with the foreign partners which assume no risk; and the entire inquiry and recovery work is done by the organization.

- **The second pre-payment:** this represents 40% of the transfer price and is granted to producers after the delivery of the projected quantities (December to February). It is paid through the same credit line granted by the BNDA. The producer at this stage has paid off in kind his credit and this is before the beginning of the new campaign.

This pre-payments system established with the support of the PACCEM since the first year of the project made it possible to grant in ten years more than 4 400 000 000 CFA francs (~9.5 million USD) to producers.

The outstanding payments of producers are internal debts, which FASO JIGI recovers with its faulty members. All the loans with the obtained are entirely paid off since 1996. This situation has made it that FASO JIGI is a financially credible and stable structure. Lawyers engaged by FASO JIGI since July 2005 makes the follow-up of the repayments of outstanding payments. He follows individually owing members in agreement with concerned villages technical committees and the board members.

### Table 3. Loans and repayment situation from 1996 to 2008

<table>
<thead>
<tr>
<th>Campaign</th>
<th>Total Loans Granted (CFA fr.)</th>
<th>Repayments</th>
<th>Unpaid</th>
<th>Repayment Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996 - 1997</td>
<td>71 234 382</td>
<td>71 234 382</td>
<td>0</td>
<td>100.0%</td>
</tr>
<tr>
<td>1997 - 1998</td>
<td>112 644 000</td>
<td>112 549 430</td>
<td>94 570</td>
<td>99.9%</td>
</tr>
<tr>
<td>1998 - 1999</td>
<td>150 589 800</td>
<td>150 585 055</td>
<td>204 745</td>
<td>99.9%</td>
</tr>
<tr>
<td>1999 - 2000</td>
<td>299 135 150</td>
<td>296 987 354</td>
<td>2 147 796</td>
<td>99.3%</td>
</tr>
<tr>
<td>2000 - 2001</td>
<td>546 065 500</td>
<td>540 371 698</td>
<td>5 693 802</td>
<td>99.0%</td>
</tr>
<tr>
<td>2001 - 2002</td>
<td>561 484 500</td>
<td>551 972 776</td>
<td>9 511 724</td>
<td>98.3%</td>
</tr>
<tr>
<td>2002 - 2003</td>
<td>680 630 000</td>
<td>669 581 715</td>
<td>11 048 285</td>
<td>98.4%</td>
</tr>
<tr>
<td>2003 - 2004</td>
<td>977 863 160</td>
<td>929 782 528</td>
<td>48 080 632</td>
<td>95.1%</td>
</tr>
<tr>
<td>2004 - 2005</td>
<td>1 056 612 211</td>
<td>1 001 358 649</td>
<td>55 253 562</td>
<td>94.8%</td>
</tr>
<tr>
<td>2005 - 2006</td>
<td>1 400 000 000</td>
<td>1 378 200 000</td>
<td>21 800 000</td>
<td>98.44%</td>
</tr>
<tr>
<td>2006 - 2007</td>
<td>1 721 000 000</td>
<td>1 711 000 000</td>
<td>10 000 000</td>
<td>99.41%</td>
</tr>
<tr>
<td>2007 - 2008</td>
<td>1 950 000 000</td>
<td>1 900 000 000</td>
<td>50 000 000</td>
<td>97.43%</td>
</tr>
</tbody>
</table>

Source: Data collected by FASO JIGI Cooperatives, 2008

**Group purchase of inputs:** This concerns mainly fertilizers needed by producers for their crops. Having the cash, producers organize group purchases of fertilizer every planting period to obtain moderate prices and good quality products on time. FASO JIGI, during the 2007-2008 campaign, made purchased 2 900 tons of fertilizer for its members. The professionalism of the organization in negotiations has made it possible to obtain a price reduction up to 32 % in the "Office du Niger", thus creating precedence in the country and this is quoted as an example by the Malian government.

**Collective marketing of cereal:** Producers’ projected quantities of cereal are collected first in all the villages after which they are gathered in the central stores at urban and semi-urban areas: Segou and Bla. The gathering allows the organization to negotiate better sales and not scatter its efforts. Central stores, belonging to the private people are usually rented for this purpose. Cereal marketing is done with mainly wholesalers from March to September and the wholesalers have to pay cash before any cereal removal. The results, in terms of volume and cash, for the last ten years of marketing are presented in Table 4.
Table 4. Quantities of marketed cereal and respective turnover from 1996 to 2005

<table>
<thead>
<tr>
<th>Campaign</th>
<th>Cooperatives (#)</th>
<th>Marketed Quantities (t)</th>
<th>Turnover (CFA fr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996 - 1997</td>
<td>18</td>
<td>511</td>
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<tr>
<td>2007 - 2008</td>
<td>134</td>
<td>9 896</td>
<td>2 745 000 000</td>
</tr>
</tbody>
</table>

Source: Data collected by FASO JIGI Cooperatives, 2008.

**FASO JIGI’s self-financing programme:**

The financial autonomy of FASO JIGI is projected from dues collected and sold volumes. The constant growth of the collected tonnages is in direct link with their strategic development plan. To assure its functioning and protect itself with its financial partners, FASO JIGI established and operates several funds.

**The functioning fund:** made up of deductions from FASO JIGI marketed bags at the rate of 7 CFA/kg for the rice, 3.5 CFA/kg for dry cereal and 4 CFA/kg for shallots; and members annual contributions which are 5000 CFA by member cooperatives. It ensures more than 65% of the functioning of FASO JIGI.

**The security fund:** represents a 3% deduction of FASO JIGI’s turnover and serves to absorb producers’ outstanding payments with financial structures during the repayment of the organization credits. This system of security fund allows FASO JIGI to have no financial debt with any financial structure as at today. The organization itself gets back outstanding payments from its faulty members.

**The marketing fund:** about 0.2% of the turnover; it helps to finance the activities connected with the achievement of good marketing of cereals such as advertisements, participation in fairs or in agricultural stock exchanges organized in Mali and in the sub region.

**FASO JIGI training:**

The PACCEM project had organized training programmes for FASO JIGI members over 10 years on varied subjects such as the roles and responsibilities of elected members, collective marketing system, store management, and democracy and transparency within groups. A functional Alphabetization and management program was launched in 2005 for 330 persons. All the women groups are registered for this programme. Haskell and Campbell (2003) were of the view that members of the cooperative members should be given necessary and adequate training.

**Constraints**

The major constraints identified with the FASO JIGI scheme by the three groups of cooperative members include:

1. Riskiness of grain speculation (97%, 89%, 92%).
2. Providing credits on speculation, which at times results in defaults (86%, 67%, 72%).
3. Theft of grains from warehouses (64%, 45%, 56%).
4. Natural disaster such as drought (58%, 59%, 67%).
5. Poor value addition (69%, 77%, 80%).
6. Social pressures on management leading to poor decisions at times concerning the timing and pricing of purchases and sales (44%, 41%, 48%).
7. Non adhesion of cooperative members from other grain crops (51%, 57%, 61%).

**Conclusion and recommendations:**

Although the idea of the formation of FASO JIGI smallholder cooperative came from outside the scheme, FASO JIGI happened to be compatible to the local situation and it is meeting the needs...
of farmers in the region. Rules and regulations are formed locally and its management allowed for full participation of farmers with some evidence of social benefits proved by the general harmony amongst members.

However, more effort should be given to members on grain market speculations, and FASO JIGI should construct its own storage facilities to reduce costs as well as acquire grain processing technologies to add value to the grains and train members on the use of these technologies.

Lessons learnt

FASO JIGI is an example of successful smallholder cooperative society in Mali and its operation could be replicated in other regions of Mali. Cooperative members, if well managed and monitored, could obtain credit and pay back on time.

References


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Construction of socio–economic status indexes for heads of rural farm families in the central Agricultural Zone of Delta State, Nigeria

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Abstract. The specific objectives of the study were to collate, and validate socio-economic status indicators for heads of farm families in the agricultural zone. Stratified and multi-stage simple random sampling techniques were used in selecting the towns and respondents. Five percent (5%) of the respondents which corresponded to 147 heads of farm families were selected to constitute the sample. Data were collected by the use of interview schedule. The uniform scoring method was used to measure the variables. Data were analysed by the use of t-test and Point-Biserial correlation coefficient. A universe of 110 socio economic status indicators were collated. Sixty seven (67) socio-economic status indicators were valid. The valid socio-economic status indicators could be constructed into a scale to measure the socio-economic status of the heads of farm families in the agricultural zone. The knowledge of the socio-economic status of farm families is necessary in predicting the adoption behaviour and socio-economic well-being of the farmer.

Key words: construction, indexes, validation, item analysis, socio-economic status

Introduction

This research work was necessitated by the fact that many researchers make use of single factor indices, particularly occupational prestige, in assessing socio-economic status of families. For instance, Straus (1969) assigned high socio-economic status to white collar workers and high income farmers. He assigned low socio-economic status to manual workers and low income farmers. According to the Family Encyclopaedia (2010) the very earliest measures of socio-economic status in North America relied on community reputation. A families social standing, as judged by others, was used to differentiate between upper, middle and lower classes. Later, prestige studies were conducted to judge the social standing of different occupations. Recently, scholars of inequality in North America have moved away from single scales of socio-economic status to an amalgam of measures. Researchers now asked a set of questions related to socio-economic status such as level of education, earnings, home ownership, occupation of wives and husbands and net value of family home.

Similarly, Marks (1998) stated that socio-economic status indices were derived from the codes assigned to occupations. He maintained that before the mid 1980s, occupations in the census were generally assigned occupation codes from the Australian Bureau of Statistics (ABS) Classification and Classified List of Occupations (CCLO). He noted that that socio-economic status could be derived from single measures or calculated from several variables related to occupational status. Most often single-based measures were derived from responses to questions on occupations of the respondents. In contrast, multiple measures could be derived from a range of variables including father’s and mother’s occupation, educational attainment, income, possessions (such as video recorder, television, cars and size of home), number of books in the home and home ownership. He found that multiple measures have stronger correlations with school achievement than single measures. This implied that multiple measures capture aspects of socio-economic background which were not captured by single measures.

From the foregoing, it could be surmised that the use of multiple measures was the best approach to measuring socio-economic status. However, most researchers find it difficult to generate multiple indexes that could be used to measure socio-economic status. The multiple measures approach involves collation and item analysis of socio-economic status indicators for the purpose of determining valid items which could be used to measure socio-economic status. The valid items are regarded as good measures of socio-economic status.

According to Instructional Assessment Resource (IAR 2007), item analysis involved many statistics that could provide useful information for improving the quality and accuracy of multiple or true-false items (questions). The item analysis procedures include item difficulty, item discrimination, reliability coefficient and distractor evaluation. Item difficulty, also known as p-value, was calculated by dividing the number of students who got an item correct by the total number of students who answered it. Ali et al. (1988) expressed item difficulty as the percentage of the upper 1/3 of candidates who got the item correct divided by the total number in both the upper 1/3 and lower 1/3 groups of candidates. IAR (2007) rated items with p-values.
above 0.90 as very easy and below 0.20 as difficult. The IAR, advised that very easy and difficult items should be revised before including them in the total test items.

Item discrimination or discriminating power of a test indicates how a test discriminates between poorer and better examinees. A good test item should be answered correctly more often by students who perform better in the overall test. IAR (2007) stated that item discrimination was the relationship between how well students did on the item and their total examination scores. The value ranges between -1.00 to 1.00. The higher the value the more discriminating is the item. A highly discriminating item indicated that students with high scores in the examination got the item correct whereas students who had low scores got the item wrong. Items with discrimination values near or less than zero should be removed from the examination because it showed that students who did poorly in the examination did better on the item than students who performed well in the examination. They mentioned that item discrimination was also referred to as the Point-Biserial correlation (PBS).

The formula for item discrimination could be expressed as IAR (2007):

\[ r = \frac{(c - t) \cdot p}{SD_{Total}} \sqrt{q} \]

where:
- \( r \) = discrimination index
- \( c \) = the mean total score for persons who got the item correct
- \( t \) = mean total score for all candidates
- \( p \) = difficulty value for the item
- \( q \) = \((1 - p)\)
- \( SD_{Total} \) = Standard Deviation of total examination score

Ovwigho (2009) made use of the Point - Biserial correlation and the t-test in calculating the indexes of dichotomous and quantitative socio-economic status indicators respectively. The modified Point- Biserial correlation formula was as follows:

\[ r_{pbis} = \frac{MP - MN}{ST} \cdot \sqrt{P(1 - P)} \]

where:
- \( r_{pbis} \) = Symbol for Point – Biserial correlation
- \( MP \) = Mean criterion score for heads of farm families who possessed the item.
- \( MN \) = Mean criterion score for heads of farm families who did not possess the item.
- \( ST \) = Standard deviation of the criterion scores
- \( P \) = Proportion of heads of farm families who possessed the item.

The modified t-test formula was as follows (Joe 1992):

\[ t = \frac{x_1 - x_2}{\sigma(x_1 - x_2)} \]

\[ \sigma(x_1 - x_2) = \sqrt{\frac{SS_1 + SS_2}{N_1 + N_2} \cdot \frac{N_1 + N_2}{N_1 + N_2}} \]

where:
- \( \sigma(x_1 - x_2) \) = estimated standard error of the difference between the means
- \( x_1 \) = mean score for upper 25 % group of the farm families
- \( x_2 \) = mean score for lower 25% group of the farm families
- \( SS_1 \) = sum of squares for sample 1 (upper group)
- \( SS_2 \) = sum of squares for sample 2 (lower group)
- \( N_1 \) = sample size for upper group
- \( N_2 \) = sample size for lower group

Gronlund (1976) expressed item discrimination with the following formula

\[ DI = \frac{RIU - RIL}{4T} \]

where:
- \( DI \) = Discrimination Index
- \( RIU \) = Number of persons in the upper group who got the item right
- \( RIL \) = Number of persons in the lower group who got the item right
- \( T \) = Total number of persons in both upper and lower groups.
This study is concerned with calculating the indexes of socio-economic status indicators with a view to selecting the valid indicators. The specific objectives were to:

8. collate a universe of socio-economic status indicators, and
9. validate socio-economic status indicators

Methodology

Sampling techniques and sample size

Stratified and multi-stage simple random sampling techniques were used in selecting the towns and respondents. Delta central agricultural zone is made up of 10 Local Government Areas. The indigenes speak Urhobo and Isoko languages (Delta Agricultural Development Programme, DADP 2005). The ten (10) Local Government Areas were previously grouped into five before they were split into two each in 1991. The ten Local Government Areas were grouped into 5 on the basis of the old Local Government map. One Local Government Area was randomly selected from each group. Twenty percent (20%) of the rural towns corresponding to Ughelli South (6), Ethiope East (4), Okpe (3), Udu (5), and Isoko North (4) were randomly selected. Five percent (5%) of the heads of the rural households which corresponded to Ughelli South (33), Ethiope East (31), Okpe (27), Udu (15) and Isoko North (41) were randomly selected. Thus the sample size was 147 heads of rural households.

Measurement of variables

The variables were socio-economic status indicators. A pre-research survey was carried out to determine items which enhance socio-economic status of individuals in the agricultural zone. One contact farmer and an opinion leader were selected from each of the 10 local government areas to constitute the sample for the pre-research survey resulting in 20 heads of farm families. The pre-research respondents were identified by asking any adult member of the community to show us the contact farmer and opinion leader. However, the main research was with the unregistered and registered farmers with the DADP in the community. Items from the pre-research survey were built into an interview schedule. A uniform scoring method which assigned a value of one (1) for possession and zero (0) for non-possession was used to measure dichotomous items. A dichotomous item was one which required a yes or no answer. A quantitative item was one in which an individual could have up to 6 or more options for an item. This meant that for quantitative items, possession scores ranged from zero (0) to six (6) or more depending on the number of items listed against the indicator. Based on the responses, a score was obtained for each individual. The scores were arranged in a descending or ascending order to form the criterion scores. The heads of farm families were asked to explain qualitatively why some of the valid indicators had social value in the community.

Method of data analysis

Data were analysed by the use of Point-Biserial correlation and t-test for dichotomous and quantitative items respectively. The correlation between possession and non-possession scores for each item was found (Table 1). Items with rpbs 0.55 and above were selected as valid for dichotomous items. The upper 25% and lower 25% of the scores for quantitative items were compared by the use of t-test at 0.01 level of significance. Significant items were selected as valid (Table 2). Ovwigho (2009) and Akinola and Patel (1987) made use of the t-test in validating quantitative measures of socio-economic status.

Results

Universe of socio-economic status indicators

One hundred and twenty one items were collated from the pre-research survey. The 121 items were pre-tested by finding out ambiguous and localized items. The localized items were items possessed only by very low and high socio-economic status heads of farm families. These items had perfect negative value (-1) or perfect positive value (+ 1) discrimination indexes. Old fashioned items and those found in only poor communities were regarded as ambiguous. Eleven ambiguous and localized items were removed from the initial universe of indicators. These items were: Pick up vans, Pit toilet, Cooking retort stand, Lap top, Desk top, Security guards, Satellite dish, Torch light, Outside brooms, Mud house, and Grinding mortar. This brought the universe of socio-economic status indicators to 110 items.

Validation of socio-economic status indicators

The universe of socio-economic status indicators were subjected to item analysis by use of Point-Biserial correlation and t-test. The analytical procedures for dichotomous and quantitative items are presented in Tables 1 and 2 respectively.
Table 1. Item analysis of ownership of traditional beads (dichotomous item)

<table>
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<th>No</th>
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<tr>
<td><strong>Total</strong></td>
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<td>100</td>
<td>147</td>
</tr>
</tbody>
</table>

\[ rpbis = \frac{MP - MN}{St} \sqrt{P \cdot (1-P)} \]

where:

MP = 127.55, MN = 64.56
St = 45.56, P = 0.32
\[ rpbis = \frac{127.55 - 64.56}{45.56} \sqrt{0.32 \cdot (1-0.32)} \]
\[ = 1.38 \times 0.47 \]
\[ = 0.65 \]

Decision = Item is a strong indicator of socio-economic since it is above 0.55.
Table 2. Item analysis of number of children (quantitative item)

<table>
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<th>Possession Scores</th>
<th>Criterion Scores</th>
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<td>2</td>
<td>-</td>
<td>-</td>
<td>14</td>
<td>-</td>
<td>16</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
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<tr>
<td>25</td>
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<td>3</td>
<td>-</td>
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<td>2</td>
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<td>20</td>
<td></td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>8</td>
</tr>
</tbody>
</table>

\[
\bar{x}_{\text{upper}} = 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
3, 3, 2, 2, 2, 2, 2, 2, 2,
\]

\[
\bar{x} = \frac{128}{37} = 3.46
\]

\[
\bar{x}_{\text{lower}} = 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4,
3, 3, 2, 2, 2, 2, 2, 2, 2,
\]

\[
\bar{x} = \frac{81}{28} = 2.89
\]

\[
\sigma = \sqrt{\frac{462 - \frac{(128)}{37} + 255 - \frac{(81)}{28}}{37+28-2} \cdot \frac{37+28}{37+28}} = \sqrt{0.63 \times 0.06} = 0.19
\]
\[
t = \frac{3.64 - 2.89}{0.19} = 2.938
\]
\[t = 2.93, P < 0.05\]

Decision: The item was valid.

**Valid socio-economic status indicators**

The valid socio-economic status indicators were selected by inspection of the indexes after the item analysis. Dichotomous items which had indexes of 0.55 and above were selected as valid. Quantitative items above the Table values were selected as valid. Sixty seven (67) items were found to be valid measures of socio-economic status of farm families in the study. The valid items are presented in Table 3

**Discussion**

*Advantages of the methods of data analysis*

The Point-Biserial correlation is advantageous over other item analysis techniques because it takes into cognizance the scores of every individual or test taker in the item analysis. The technique has been found quite suitable for analysis of dichotomous items requiring yes or no answers. The t-test is most suitable for quantitatively measured items. However, the application of the t-test for item analysis of quantitative items does not take into cognizance the responses of all individuals. An upper 25% and lower 25% of high and low scores were compared by the use of t-test. The present study is an improvement over the work of Akinola and Patel(1987) because it showed clearly the quantity of each items that were used in the data analysis. They also made use of t-test in analysing both dichotomous and quantitative items. This meant that about 50% of the respondents were left out for the analysis of dichotomous items. In item analysis efforts should be made toward including all respondents’ scores in the data analysis. It is also wrong for researchers to assign socio-economic status to individuals in a society merely on the basis of occupation without empirical validation of the indicators of social status in that society. These methods of data analysis are, therefore, recommended to other researchers in the field of social stratification and mobility in human societies.

**Characteristics of valid items**

Table 3, showed the 67 items which were found valid out of the universe of 110 socio-economic status indicators in the study area. A valid item is one that discriminates between high and low socio-economic status respondents. A valid item should not be too strong or weak measure of socio-economic status. The valid items in this study could be classified into cultural, material, income and social participation items. Some cultural possession items were number of wives, number of children, number of relatives trained by you, traditional beads, traditional attires, walking sticks, traditional hats, George wrappers, single wrappers and Chieftaincy title. The people have high regards for children and wives. They regard children as wealth and gifts from God. People without children were often regarded as irresponsible and castigated as infertile members of the society who have not been able to perpetuate themselves in the society. In primordial times, children were also used as source of rural farm family labour. Ovigho (2008) observed that a man without children could go to a beer parlour and drink to forget himself but a married man with children cannot indulge in such behaviour.

The permissive nature of the extended family system practiced in many parts of Africa allows an individual to have as many children as possible. In the course of the study the researcher came across a man with 91 children. Having large number of children is now alien to the European culture where population control has been practiced. Ovigho and Ifie (2009) noted that population control in most countries of Africa could best be described as a matter of theory and not practice. For instance, in Nigeria population control has not been made a policy trust for reducing crime, hunger and deprivation. Today, traumatic economic experience and austerity have resulted in the younger generation practicing monogamy and giving birth to fewer children. A person with more than one wife was regarded as a highly placed person in the traditional communities within the study area. Sometimes, you find a person with two wives boasting and asking another person with one wife a question like, 'how many wives do you have that you are talking here?'
### Table 3. Valid socio-economic status indicators

<table>
<thead>
<tr>
<th>S/NO</th>
<th>Item</th>
<th>Statistical Tool</th>
<th>Discrimination Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Number of wives</td>
<td>t</td>
<td>5.107</td>
</tr>
<tr>
<td>2</td>
<td>Number of children</td>
<td>&quot;</td>
<td>2.938</td>
</tr>
<tr>
<td>3</td>
<td>Children in primary school</td>
<td>&quot;</td>
<td>4.681</td>
</tr>
<tr>
<td>4</td>
<td>Children in secondary school</td>
<td>&quot;</td>
<td>2.978</td>
</tr>
<tr>
<td>5</td>
<td>Number of relatives trained by you up to secondary level</td>
<td>&quot;</td>
<td>4.630</td>
</tr>
<tr>
<td>6</td>
<td>Traditional beads</td>
<td>rpbs</td>
<td>0.650</td>
</tr>
<tr>
<td>7</td>
<td>Necklace</td>
<td>&quot;</td>
<td>0.630</td>
</tr>
<tr>
<td>8</td>
<td>Ownership of cement house in the village</td>
<td>&quot;</td>
<td>0.750</td>
</tr>
<tr>
<td>9</td>
<td>Ownership of cement house outside the village</td>
<td>&quot;</td>
<td>0.610</td>
</tr>
<tr>
<td>10</td>
<td>Earth plates</td>
<td>t</td>
<td>4.200</td>
</tr>
<tr>
<td>11</td>
<td>Walking sticks</td>
<td>&quot;</td>
<td>5.105</td>
</tr>
<tr>
<td>12</td>
<td>Traditional hats</td>
<td>&quot;</td>
<td>3.529</td>
</tr>
<tr>
<td>13</td>
<td>Traditional attires</td>
<td>&quot;</td>
<td>15.750</td>
</tr>
<tr>
<td>14</td>
<td>Pair of shoes</td>
<td>&quot;</td>
<td>3.581</td>
</tr>
<tr>
<td>15</td>
<td>George wrapper</td>
<td>&quot;</td>
<td>11.200</td>
</tr>
<tr>
<td>16</td>
<td>Single wrapper</td>
<td>&quot;</td>
<td>5.484</td>
</tr>
<tr>
<td>17</td>
<td>Rooms with cemented floor</td>
<td>&quot;</td>
<td>28.100</td>
</tr>
<tr>
<td>18</td>
<td>Personal well</td>
<td>rpbs</td>
<td>0.670</td>
</tr>
<tr>
<td>19</td>
<td>Chieftaincy title</td>
<td>&quot;</td>
<td>0.550</td>
</tr>
<tr>
<td>20</td>
<td>Cutlasses</td>
<td>t</td>
<td>10.625</td>
</tr>
<tr>
<td>21</td>
<td>Spade/shovel</td>
<td>&quot;</td>
<td>8.125</td>
</tr>
<tr>
<td>22</td>
<td>Hand hoes</td>
<td>&quot;</td>
<td>5.938</td>
</tr>
<tr>
<td>23</td>
<td>Wash hand basins</td>
<td>rpbs</td>
<td>0.550</td>
</tr>
<tr>
<td>24</td>
<td>Cabinet beds</td>
<td>t</td>
<td>7.684</td>
</tr>
<tr>
<td>25</td>
<td>Framed photographs of yourself</td>
<td>&quot;</td>
<td>11.429</td>
</tr>
<tr>
<td>26</td>
<td>Farm size</td>
<td>&quot;</td>
<td>15.550</td>
</tr>
<tr>
<td>27</td>
<td>Poultry birds</td>
<td>&quot;</td>
<td>6.612</td>
</tr>
<tr>
<td>28</td>
<td>Fish ponds</td>
<td>&quot;</td>
<td>6.900</td>
</tr>
<tr>
<td>29</td>
<td>Hired labourers</td>
<td>rpbs</td>
<td>0.580</td>
</tr>
<tr>
<td>30</td>
<td>Plots of land owned in the village</td>
<td>t</td>
<td>9.785</td>
</tr>
<tr>
<td>31</td>
<td>Personal bore-hole</td>
<td>rpbs</td>
<td>0.550</td>
</tr>
<tr>
<td>32</td>
<td>Motor cycle</td>
<td>&quot;</td>
<td>0.580</td>
</tr>
<tr>
<td>33</td>
<td>DVD/CD Player</td>
<td>&quot;</td>
<td>0.550</td>
</tr>
<tr>
<td>34</td>
<td>GSM Handsets</td>
<td>&quot;</td>
<td>0.640</td>
</tr>
<tr>
<td>35</td>
<td>Radio/Cassette players</td>
<td>&quot;</td>
<td>0.550</td>
</tr>
<tr>
<td>36</td>
<td>Television</td>
<td>&quot;</td>
<td>0.600</td>
</tr>
<tr>
<td>37</td>
<td>Ceiling/Table fans</td>
<td>t</td>
<td>3.667</td>
</tr>
<tr>
<td>38</td>
<td>Executive chairs</td>
<td>rpbs</td>
<td>0.550</td>
</tr>
<tr>
<td>39</td>
<td>Stove</td>
<td>&quot;</td>
<td>0.730</td>
</tr>
<tr>
<td>40</td>
<td>Gas cooker</td>
<td>&quot;</td>
<td>0.550</td>
</tr>
<tr>
<td>41</td>
<td>Wheel barrow</td>
<td>&quot;</td>
<td>0.810</td>
</tr>
<tr>
<td>42</td>
<td>Floor carpet</td>
<td>&quot;</td>
<td>0.590</td>
</tr>
<tr>
<td>43</td>
<td>Wall clock</td>
<td>&quot;</td>
<td>0.560</td>
</tr>
<tr>
<td>44</td>
<td>Rain coats</td>
<td>&quot;</td>
<td>0.580</td>
</tr>
<tr>
<td>45</td>
<td>Umbrella</td>
<td>t</td>
<td>5.548</td>
</tr>
<tr>
<td>46</td>
<td>Book shelves</td>
<td>rpbs</td>
<td>0.590</td>
</tr>
<tr>
<td>47</td>
<td>Standing mirror</td>
<td>&quot;</td>
<td>0.630</td>
</tr>
<tr>
<td>48</td>
<td>Dining table</td>
<td>&quot;</td>
<td>0.550</td>
</tr>
<tr>
<td>49</td>
<td>Metal buckets</td>
<td>t</td>
<td>8.933</td>
</tr>
<tr>
<td>50</td>
<td>Plastic buckets</td>
<td>&quot;</td>
<td>6.529</td>
</tr>
<tr>
<td>51</td>
<td>Blender</td>
<td>rpbs</td>
<td>0.570</td>
</tr>
<tr>
<td>52</td>
<td>Frying pan</td>
<td>&quot;</td>
<td>0.680</td>
</tr>
<tr>
<td>53</td>
<td>Tumbles</td>
<td>t</td>
<td>14.290</td>
</tr>
<tr>
<td>54</td>
<td>Kettle</td>
<td>&quot;</td>
<td>3.931</td>
</tr>
<tr>
<td>55</td>
<td>Bicycles</td>
<td>&quot;</td>
<td>9.930</td>
</tr>
<tr>
<td>56</td>
<td>Metal spoons</td>
<td>&quot;</td>
<td>14.526</td>
</tr>
<tr>
<td>57</td>
<td>Suitcases/Travelling bags</td>
<td>&quot;</td>
<td>3.750</td>
</tr>
<tr>
<td>58</td>
<td>Hurricane lantern</td>
<td>&quot;</td>
<td>14.909</td>
</tr>
<tr>
<td>59</td>
<td>Glass plates</td>
<td>&quot;</td>
<td>21.563</td>
</tr>
<tr>
<td>60</td>
<td>Ownership of wrist watch</td>
<td>rpbs</td>
<td>0.700</td>
</tr>
<tr>
<td>61</td>
<td>Ability to read in English</td>
<td>&quot;</td>
<td>0.730</td>
</tr>
<tr>
<td>62</td>
<td>Ability to write in English</td>
<td>&quot;</td>
<td>0.730</td>
</tr>
<tr>
<td>63</td>
<td>Ability to read native dialect</td>
<td>&quot;</td>
<td>0.690</td>
</tr>
<tr>
<td>64</td>
<td>Membership of social clubs</td>
<td>&quot;</td>
<td>0.590</td>
</tr>
<tr>
<td>65</td>
<td>Membership of village executive leaders</td>
<td>&quot;</td>
<td>0.590</td>
</tr>
<tr>
<td>66</td>
<td>Official in a Christian organization</td>
<td>&quot;</td>
<td>0.560</td>
</tr>
<tr>
<td>67</td>
<td>Membership of cooperative societies</td>
<td>t</td>
<td>8.462</td>
</tr>
</tbody>
</table>
Cultural possession items such as walking sticks, traditional hats, George and single wrappers constitute part of the traditional attires. The numbers of traditional attires owned by the individual were regarded as measures of his social status. A genuine Chief is one with good amount of wealth, high spiritual altruism and one that is respected by the people. Nowadays some people pay money to obtain it in the study area. Chieftaincy titles are supposed to be conferred only on worthy members of the society who have contributed their time energy, money and resources to the advancement of their immediate communities.

The material possession items include bicycle, motor cycles, personal well, wash hand basins, beds, personal bore-hole, television, DVD/CD players, GSM handsets, radio/cassette players, stove, gas cooker, number of rooms with cemented floors, and ownership of cement house in the village. Bicycles and motor cycles were the valid and popular means of transportation in the study area. Motor cars were not valid because only an insignificant number of the respondents in high status categories have them.

The income generation items include farm size, fish ponds, poultry birds, hired labourers, plots of land owned in the village, house(s) outside the village and wheel barrows. Plots of land owned by the individual represent potential wealth or stored capital for the individual and inheritance for the children. A person with plenty of undeveloped land is regarded as a wealthy person in the study area. Ownership of cement house(s) outside the village gives the owner additional income in the form of house rent. A house owned by the individual in the village seldom gives additional income to the Landlords hence it was classified as a material possession item. The rural people usually keep poultry under the free range system for consumption and sale during festivals. The fish ponds were constructed on seasonally flooded plains and were harvested during dry season.

The social participation items were membership of cooperative societies, membership of village executive council of leaders, membership of social clubs, and ability to read and write in English, and read native dialect. People who possess these social participation items were often the educated members of the community with better social and economic status than the average member of the community.

Conclusion

Many researchers in Nigeria avoid constructing indexes of socio-economic indicators because of the lack of the technical know-how and time. This study came up with 67 socio-economic status indicators which could be used to measure socio-economic changes among farm families in the study area. The items were the statistically valid indicators of socio-economic status in the study area. There are many rural development intervention programmes in the study area which could be evaluated by changes in socio-economic status. The 67 valid measures of socio-economic status could be used to construct a socio-economic status scale for measuring changes in socio-economic status of farm families in the study area.

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Adoption of centre pivot irrigation in the irrigated dairy industry of south-eastern Australia

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Abstract. This paper reports on a study to answer the research question; why do dairy farmers adopt (or not adopt as the case may be) centre pivot irrigation (CPI) in the Central Goulburn Irrigation District (CGID) of southeastern Australia? Twenty-two dairy farmers were interviewed. Ten of these farmers had adopted CPI, four were considering adopting, and eight of the farmers were not planning to adopt CPI. The farmers interviewed represented the range of irrigated dairy farm sizes and production practices found within the CGID. The interviews were conducted and the data analysed as per the methods developed by Kaine (2004; 2008). We found that dairy farmers in the CGID only adopted CPI if their farm context (the farm’s physical characteristics, the farmers’ mix of skills and existing practices) meant that CPI would provide a relative advantage over alternative irrigation options. Therefore, CPI was only adopted when a farmer: required additional cattle feed; wanted to grow crops in a ‘cut and carry’ system to meet these requirements; and had access to undeveloped, physically suitable land. These findings suggest that rather than the adoption rates of CPI in the CGID being low, the market for CPI within the CGID is small. This is useful information that will enable realistic targets for adoption to be set, and guide research and extension in the CGID.

Keywords: adoption, centre pivot irrigation, irrigated dairy industry, Central Goulburn Irrigation District, southeastern Australia.

Introduction

The irrigated dairy industry in the Central Goulburn Irrigation District

The Shepparton Irrigation Region (SIR) has the highest concentration of dairy farms in southeastern Australia, with around 2,800 farmers (Linehan et al. 2004) producing 22.4% of Australia’s milk in 2006/07 (Dairy Australia, 2008). The Central Goulburn Irrigation District (CGID) sits within this region and contains 814 of these dairy farms (Linehan and McAllister 2007, see Figure 1).

The people managing these farms are currently facing an unprecedented challenge with regard to irrigation water becoming increasingly expensive and scarce due to 11 consecutive years of dry conditions (BOM 2008) and increased demand from urban, recreational and environmental users (Victorian Government 2008). In 2008/09, dairy farmers in the SIR received 33% of their water allocation if they were on the Goulburn system or 35% if they were on the Murray system. Prior to 1995, these farmers received 200% of their water allocation (GMW 2009). Meanwhile irrigation water prices rose from $20 per megalitre (pre-1999) to an average of $365 per megalitre in the 2008/09 irrigation season (Waterfind 2009).

Centre pivot irrigation

Centre pivot irrigation (CPI) is a form of sprinkler irrigation consisting of several segments of pipe (usually galvanized steel or aluminium) joined together and supported by trusses mounted on wheeled towers with sprinklers positioned along its length. The system moves in a circular pattern and water is fed from the pivot point at the centre of the arc.

Research has demonstrated that CPI can reduce water use by 5%, while increasing the productivity of perennial pasture by 10%, compared to the traditional border-check, gravity flow irrigation (Qassim et al. 2008). Converting from border-check to CPI was found to be economically feasible in the CGID (Wood et al. 2007). Other studies have found that using CPI provided farmers with a greater ability to match irrigation applications to crop water demand, with improved nutrient management, increased management flexibility and reduced labour costs (Maskey et al. 2006; Qassim et al. 2008).

Despite these advantages, and investment by the Department of Primary Industries in an extensive program of research and extension, adoption of CPI was perceived to be low in the CGID (Maskey et al. 2006). Pomfret (2000) reported adoption of CPI at less than 10%, while Maskey et al. (2006) reported that less than 2.5% of the dairy farms in the CGID had adopted CPI. We did not find any published information on the level of adoption of CPI in other regions or industries.
Figure 1: Location of dairy farms in the Central Goulburn Irrigation District

Source: Linehan and McAllister (2007)

The benefits and barriers to adoption of CPI

Seeking to understand why adoption of CPI was low, Maskey et al. (2006) surveyed 20 dairy farmers in the CGID who had adopted CPI. They questioned the farmers about the benefits of, and barriers to adopting this irrigation system. The major benefits the farmers were seeking through their adoption of CPI were saving water through reduced runoff and saving labour as CPI is an automated system (Maskey et al. 2006). Foley and Raine (2001) found that cotton growers in Queensland sought the same benefits through their adoption of CPI. The barriers dairy farmers rated as most important were: the capital cost of the equipment, presence of trees, and the operating and maintenance costs of the system (Maskey et al. 2006).

An assumption that CPI could potentially be adopted on all irrigated dairy farms in the CGID underpinned the Maskey et al. (2006) study. Hence the benefits and barriers identified were the major factors influencing the adoption of CPI. If this assumption was correct, the adoption of CPI should be much higher as saving water and labour was, and continues to be, important to all dairy farmers in their efforts to reduce costs and increase productivity in order to remain financially viable (Bethune & Armstrong 2004). Yet only 2.5% of the dairy farmers in the CGID had adopted CPI. Therefore, the research question for this study was, Why did dairy farmers in the CGID adopt CPI?

Adoption research

Adoption research literature was referred to, but did not reveal a consistent approach to understanding the adoption of agricultural innovations, with different studies producing inconsistent, inconclusive or even mutually contradictory results (Feder et al. 1985; Knowler & Badshaw 2007; Kaine 2008). Kaine (2008) suggests that part of the reason for this confusion is that there are a number of theories as to why primary producers adopt agricultural innovations. Kaine (2008) illustrates this point by highlighting that the theory of technology transfer and diffusion of innovations emphasises the innovativeness of the producer, farming systems theory emphasises producer participation in the research process, and other theories emphasise learning and human development as the key determinants of adoption. In the adoption research literature there has also emerged an understanding of innovation as a socially and territorially...
embedded process (Koutsouris 2009), with adoption of innovations depending on a range of personal, social, cultural and economic factors as well as on characteristics of the innovation itself (Vanclay 2004; Pannell et al. 2006). Marra et al. (2001) described adoption as a function of the farm, the farmer and the characteristics of the innovation.

One thing most adoption researchers agree on is that the individual considering adoption must perceive that the innovation or technology will provide a ‘relative advantage’ or additional benefit above that provided by the individuals’ current practice (Rogers 1995; Vanclay 2004; Pannell et al. 2006). From a farm systems perspective the benefits (and costs) of adopting a new technology such as CPI will depend on how the CPI integrates with certain technologies, practices and resources that are already in use on the farm (Kaine and Bewsell 2008).

The Kaine framework

Kaine (2004), Kaine and Bewsell (2008) suggest that the technologies, practices and resources present on a farm are part of its “farm context”. The farm context also includes biophysical characteristics such as soil type and proximity to irrigation water, enterprise characteristics such as irrigation infrastructure and paddock size, human resources such as the availability and skill levels of available labour, and existing farm practices such as type of crop production or pasture management. These factors all combine to determine the cost, and potential benefits of adopting an innovation such as CPI. Kaine (2004; 2008) developed a framework to enable the key aspects of the farm context for a specific innovation to be identified, and hence to infer the likelihood of an innovation providing a relative advantage and potentially being adopted.

Farmers can then be sorted into market segments based on the presence of all, some or none of the key aspects on their farm. The creation of market segments enables the segments to be quantified (if required), the discrete needs of the farmers in each segment to be studied, and an opportunity to be provided to create targeted extension messages or products for the relevant segments (Kaine et al. 2005). Market segmentation has been used in agriculture before, however Kaine’s approach is the unique in that the concepts of farm context and potential benefit to underpin the segments (Kaine et al. 2005), make it suitable to use when answering our research question: Why did dairy farmers in the CGID adopt (or not adopt) CPI?

A range of information is available on the theory underpinning Kaine’s framework (Kaine 2004; 2008; Kaine et al. 2005; Bewsell et. al 2008), which has been widely used to study the adoption of a number of innovations in a range of industries. These include for example: soil moisture and automatic irrigation bay monitoring on dairy farms (Kaine and Bewsell 2002), soil moisture monitoring of pome and stone fruit (Kaine and Beswell 1999), sheep breeding and sire selection (Kaine et al. 2006) and soil management on livestock enterprises (Kaine and Niall 1999). Consequently, our study did not aim to develop or refine a new method, but rather to apply an established method to a new topic.

Methods

Twenty-two dairy farmers from the CGID were interviewed in order to identify the key issues influencing the adoption of CPI. Ten of these farmers had adopted CPI, four were considering adopting, and eight of the farmers were not planning to adopt CPI. The farmers were identified through industry and service provider contacts and represented the range of age groups, backgrounds, herd and farm sizes, and farm systems found in the CGID.

The interviews were conducted using a laddering process (Grunert and Grunert 1995). This process starts with the farmer being asked general questions about the subject of interest, with the questions becoming increasingly precise in response to the detail being provided by the interviewee (Kaine 2008). This technique enabled the systematic exploration of the reasoning underlying the decisions and actions of the interviewees. This in turn allowed the identification of similar and dissimilar patterns in reasoning among the interviewees, and the rationale for these patterns (Kaine 2008).

Interviewing farmers who had not adopted CPI helped with identification of the farm context and reasoning where adoption of CPI was not perceived to provide a benefit. Farmers considering adoption of CPI were interviewed seeking insights into the types of information and the key factors in the adoption decision-making process. The range of farmers interviewed, and use of this interviewing process allowed the elements that constitute the farm context to emerge through disclosure, testing and confirmation (Kaine 2008).

During the interviews, questions were asked about the farmers’ access to irrigation water, farm size, labour management, herd number, and farming strategies regarding perennial pasture, fodder conservation and supplementary feeding of cattle. The sampling and interviewing process was considered complete when repeated interviews did not provide any new information and the
interviewers were satisfied that they had logically consistent explanations for the patterns of reasoning and the decision making the farmers described (Kaine 2008). Two interviewers recorded interview responses manually and summarised and analysed them using case and cross-case analysis (Patton 1990).

Results

The farmers who adopted CPI met each of the following criteria. They:

- required additional cattle feed
- wanted to grow crops in a cut and carry system to meet these additional feed requirements
- had access to undeveloped land, physically suitable for CPI.

All of the dairy farmers interviewed said that the medium- to long-term viability of their farm businesses depended on them increasing, or maintaining the productivity of their farms. They found this a challenge in the face of falling milk prices, dry seasons and rising input costs. The farmers were placed into four groups based on how they responded to these challenges (see Figure 2).

**Figure 2: Decision tree of farm context leading to adoption of CPI**

1. **No major change to the farm**
   - Two of the farmers interviewed were not changing their farms to meet this challenge as they were satisfied with their existing farm system, were close to retirement, or were planning to leave the industry. They had not, and were not planning to make any major changes to their farms and therefore were not considering adopting CPI.

2. **Buying feed, expanding the milking area, and/or modifying existing farm practices**
   - Four of the farmers interviewed said they preferred to buy additional feed, often because they did not have more land, or capital available. For example, one farmer using this strategy told us:
     
     “I am expanding my herd, but I prefer to buy feed, rather than grow it. I can get hold of better quality feed that way, and someone else takes the risk of growing it“.

3. **Grow crops using irrigation other than CPI**
   - All of the other farmers interviewed were increasing their farm productivity using a range of strategies, depending on a number of factors including available capital, farm size, labour and their existing farm infrastructure, machinery and management practices. All these strategies depended, to some extent, on increasing the number of dairy cows to produce additional milk. This led to a need for additional feed for the herd.

4. **Grow crops using CPI**

   **Group 1 - No major change to the farm**

   Two of the farmers interviewed were not changing their farms to meet this challenge as they were satisfied with their existing farm system, were close to retirement, or were planning to leave the industry. They had not, and were not planning to make any major changes to their farms and therefore were not considering adopting CPI.

   All of the other farmers interviewed were increasing their farm productivity using a range of strategies, depending on a number of factors including available capital, farm size, labour and their existing farm infrastructure, machinery and management practices. All these strategies depended, to some extent, on increasing the number of dairy cows to produce additional milk. This led to a need for additional feed for the herd.

   **Group 2 - Buying feed, expanding the milking area, and/or modifying existing farm practices**

   Four of the farmers interviewed said they preferred to buy additional feed, often because they did not have more land, or capital available. For example, one farmer using this strategy told us:

   “I am expanding my herd, but I prefer to buy feed, rather than grow it. I can get hold of better quality feed that way, and someone else takes the risk of growing it“. 
Other farmers had decided to grow additional feed on farm. These farmers had access to additional land, either through purchasing or leasing developed blocks, or through developing “green sites” (previously undeveloped blocks). If the additional land was within 1 km of the dairy, the farmers had the option of extending their ‘milking area’, which is pasture for the cattle to graze on. If the land was more than 1 km away from the dairy, the farmers said it was too far to walk the cows there and back twice a day to milk them. None of these farmers adopted CPI because they did not perceive that growing perennial pasture under CPI was economically viable.

Jamie is a farmer using this strategy (names of farmers have been changed to protect anonymity). Jamie told us:

“I am growing better and more grass to feed my cows. I have not invested in CPI as I don't see how growing pasture can justify the capital investment and operating costs”.

Some farmers spoke about increasing the productivity of their existing land, or farms through changing pasture species, pasture management practices and/or aspects of their herd genetics or husbandry. Some of the farmers used two or all three of these approaches at the same time. These farmers suggested that these were incremental changes, limited by a number of dry seasons and lack of capital. This group of farmers were not considering adopting CPI.

**Group 3 - Grow crops using irrigation other than CPI**

Two of the farmers interviewed had obtained access to additional land, or were using part of their existing farm to produce additional feed as part of a cut and carry system. In a cut and carry system the farmer grows the fodder, harvests and stores it, and then feeds it to the cattle as required, using a feed pad or a feed pad/pasture combination.

If the existing or additional land was already developed none of the farmers interviewed said they were prepared to plough in an existing functional irrigation system to adopt CPI.

Mary explained to us:

“I bought this farm eight years ago. It was laid out to flood (border-check) irrigation when I bought it, and I have relaseded 25% of it since. There weren't many centre pivot irrigation systems around then. While I wouldn't mind doing things a bit more efficiently, I have spent the capital to laser grade so it would be a waste of money changing it”.

Some of the farmers interviewed had thought about adopting CPI, but their land was not physically suitable. Carl is a farmer in this situation. Carl told us:

“We were thinking about putting in a centre pivot but the paddock is on a spur channel so the water level fluctuates. We also have remnant vegetation, would have had to re-route the power line, and have only been able to irrigate ¾ of the circle. So we ended up putting the paddock under flood (border-check) irrigation”.

Therefore, the farmers in this group were not considering adopting CPI, because either their land was not physically suitable, or because they did not perceive that CPI offered sufficient benefit over their existing practices to warrant the investment.

**Group 4 – To grow crops using CPI**

Ten of the farmers interviewed had adopted CPI when they were developing a physically suitable, previously undeveloped block to grow crops in a cut and carry system. A cut and carry system means that farmers grow, harvest then store and transport the feed to the cattle as required. While requiring specialized machinery, equipment, facilities and management practices, a cut and carry system enables farmers to utilize land that is too far from the dairy to be grazed, and reduces wastage as the cattle are not trampling and fouling pasture (Hodge and Hodge 2006).

The farmers that adopted CPI did so in order to grow crops and meet the feed requirements of their large or expanding dairy herd. They had a previously undeveloped block of land suitable for CPI (over 35 hectares in size, square or circular in shape, often undulating, with light soils and access to sufficient quantity and quality irrigation water, and without obstacles such as fences, power lines, trees, holes, dams or deep ditches in it).

Robert adopted CPI, he told us:

“I spent $1,000,000 buying in feed during the first drought year, so I needed to increase our on-farm feed production. We had an undeveloped block that was
undulating, with fragile soils. CPI was the only option. I am growing annual crops under the CPI as this gives me the best nutritional value for my water”.

The farmers that had adopted CPI said that the benefits of CPI above border-check irrigation were reduced labour requirements, increased productivity per megalitre of water and managerial flexibility. These farmers also said that purchasing a CPI was a large capital investment, however many believed they would have spent as much, or more money if they had tried laser grading their undulating block. Laser grading would also have damaged the soil structure, resulting in increased water runoff and erosion, particularly on light soils.

The other four farmers interviewed were still considering adopting CPI.

Discussion
CPI can increase productivity and reduce water use, yet there was a perception that adoption of CPI was low in the dairy industry of the CGID (Maskey et al. 2006). In this study, we found that even though the farmers mentioned the benefits and barriers to adoption of CPI described by Maskey et al. (2006), they were not the only factors that determined if CPI was adopted in the CGID. Dairy farmers in the CGID only adopted CPI if they: required additional cattle feed, wanted to grow crops in a ‘cut and carry’ system to meet these requirements and had access to undeveloped land that was physically suited to CPI.

A strength of the Kaine framework is that the aspects of farm context identified as key in determining if an innovation will provide a benefit though adoption, can usually then be used to quantify the market for that innovation. This would be more difficult to do with the more subtle or dynamic characteristics often used in other adoption research, such as farmer attitudes and goals or personal and social values for example.

After this study finished some of the biophysical characteristics identified (light soils, an area of undeveloped land, and access to irrigation water) were in fact used in conjunction with spatial data by Linehan and McAllister (2007) to see if they could quantify how many dairy farms in the CGID were suited to CPI. They identified fifty-three (6.5%) out of 814 farms which had these characteristics, which may provide a better estimate of the size of the potential market for CPI in the CGIR. However if we then consider the other factors identified as contributing to the adoption of CPI, for example if the farmers that owned these farms were not: considering making major on-farm changes (group 1), using cut and carry (group 2) or developing land (group 3), the number of potential adopters would most likely drop still further.

The adoption of micro-irrigation by fruit growers
The results of this study are similar in some ways to those found by Kaine and Bewsell (1999) who studied the adoption of micro-irrigation (pressurized) systems by fruit growers. The growers’ properties had to have physically suitable soil types and access to irrigation water for micro-irrigation adoption to be possible. The fruit growers adopted micro-irrigation seeking to increase productivity through irrigating a greater number of trees, to optimize water use, reduce labor demands, and irrigate high density or trellis planted orchards. These findings are not surprising as the themes of needing to increase productivity and efficiency are reoccurring ones in the quest of the modern farmer to remain economically viable (Nossal and Gooday 2009).

Future research and extension
Consequently, research and extension work should be directed towards identifying and quantifying some of the agronomic options available to farmers. The more objective, reliable and relevant the information the farmer can access, the more chance the farmer has of making sound decisions about how to manage his/her unique farm system. We suggest that the potential use of CPI in non “cut and carry” farm system be explored in order to expand the current size of the market for this technology. If it was determined that the production of pasture was economically viable under CPI, then more of farmers managing the fifty-three farms suited to CPI (as identified by Linehan and McAllister 2007) may adopt.

In future smaller, cheaper CPI units may become available. While the farmers’ criteria of wanting to grow additional feed on farm and having a area of land physically suitable will still be relevant, if the CPI is smaller more farms may have land physically suitable. Again, this would increase the size of the market for CPI.

Conclusion
CPI offers benefits in increasing farm productivity and reducing water use, yet there was a perception that adoption of CPI was low in the dairy industry of the CGID. In this study, we found that it was not only the benefits of and barriers to adoption of CPI described by Maskey et al. (2006) that determined if CPI was adopted in the CGID, but rather, that dairy farmers
adopted CPI when developing a block of physically suitable land on which to grow crops in a cut and carry system, in order to feed a large or expanding dairy herd. A relatively low number of farmers and farms matched these criteria.

Traditionally lack of awareness about an innovation, unsatisfactory access to information or inadequate learning skills were often blamed for low rates of innovation adoption (Kaine 2005). This was not that case in relation to the adoption of CPI in the CGID. The low numbers of dairy farmers adopting CPI in the CGID does not represent a low rate of adoption, or that the extension program has failed. Instead the market for CPI is relatively small.

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References


Participatory learning for technology shaping and its dissemination: a case from Nepal

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Abstract. Agriculture in developing countries is complex and vulnerable, especially for resource-poor farmers. They require location-specific technologies and solutions developed with their active involvement. In Nepal, several top-down approaches have been tried but there appeared to be challenges in addressing the needs of poor farmers. Participatory approaches emphasise involvement of local farmers and interaction between farmers, extension workers and researchers in order to understand local needs, challenges and opportunities, and to adjust or design technology for the specific situation. This paper focuses on the joint learning process applied to the introduction of System of Rice Intensification (SRI) in Nepal. The program was conducted during 2003-2006 in the Morang district of eastern Nepal.

Keywords: Appropriate technology, SRI, participation, poor farmers, local resource, local knowledge.

Introduction
The System of Rice Intensification (SRI) is a new method of rice cultivation developed in Madagascar. It has been introduced to other parts of the world since 1999, first in China followed by Indonesia and India (Prasad 2006; Uphoff 2007), with the support of the Cornell International Institute for Agriculture Development (CIIFAD). Later it was introduced in many countries in Africa, Asia and the Americas (Prasad 2006). All countries have reported high yields of rice and profitability due to SRI (Barison 2002; Koma 2002; Anthofer 2004; Satyanarayana 2004; Kabir 2006; Sato 2006; Uprety 2006). Rice yields were increased using this method when compared to the conventional method, without increasing inputs and investment. This is the most important aspect of SRI for resource-poor farmers and less developed countries.

Following an initiative of Professor John Duxbury of Cornell University, SRI was tried rather unsuccessfully at research stations of the National Agricultural Research Council in Nepal during 1998 and 1999. In 2001, there was another trial at the Bhairahawa research station under the National Wheat Research Program. These did not show ‘the SRI effect’ either, as conventional practices gave a greater yield (by 5.6%). This seemed to establish the belief that SRI practices ‘do not work’ in Nepal (Uphoff 2007). The first time I heard about this method was in the Low External Input and Sustainable Agriculture (LEISA) magazine, which lead to correspondence with Professor Norman Uphoff about trialling it in the Morang district of eastern Nepal. At that time I did not know about the past failures of SRI in Nepal. In 2003 the first trial was conducted by the district agriculture development office (DADO) in Morang on a small plot (about 100 square meters) and the results were very encouraging. The yield was more than seven tonnes per hectare, whereas the conventional method yielded less than four tonnes per hectare at the trial area. These results were very encouraging to the DADO staff. In the following year, the number of SRI farmers and the area under SRI was increased, but problems and challenges also appeared.

SRI is a combination of principles and practices used to fully exploit the potential of the rice plant. The main technological components of SRI (Stoop et al. 2002; Uphoff 2007) include:

- Rapid, careful and shallow transplanting of very young seedlings (10–15 days old).
- Single seedling transplanting rather than clumps of 4
- Wide spacing between the plants in a square pattern (25x25 cm or wider)
- No continuous flooding (but alternate wetting and drying) during the vegetative stage and a thin layer of water (moisten soil) kept on the field during reproductive stage
- Controlling weeds by weeding with a rotating hoe and applying compost in preference to chemical fertilizers.

The main recommendations of SRI mentioned above did not work equally in every plot or were weaker than rice grown using the conventional method. This was a challenging situation for the DADO staff. The disappointing trials demonstrated the risks of SRI adoption, especially for those farmers who want to increase their rice production but are resource poor (due to unreliable water supplies, less fertile land, less investment). This paper presents the problems we found and the outcomes of working with the farmers during the SRI dissemination program.

Field activities, problems and outcomes of joint learning
I was leading the SRI movement (introduction and dissemination) in the Morang district of Nepal. I received the ‘Nepal Development Marketplace Award 2005’ (NDM 2005), organized by...
the World Bank, Nepal, to disseminate SRI in the Morang and Panchthar districts of eastern Nepal. It was a big challenge to achieve the objectives of the SRI dissemination project. There was a lot of diversity in land type, fertility status, water availability for irrigation, varieties of rice, socio-economic status of farmers, labour availability and many other aspects. In such diversified situations, we needed to speed up the SRI movement to achieve our target specified for the NDM project. To do this, it was necessary to explore the main bottlenecks and the possible solutions for the SRI farmers. DADO staff discussed the problems and it was decided to conduct an in-depth study of SRI reality in the field. During the field study farmers reported their farm condition, the SRI practices they followed and the results. The study showed that SRI performance was influenced by the farm conditions. That is, similar recommendations did not work equally everywhere and, therefore, practices had to be adjusted/reshaped according to the farming situation. It was found that following modified recommendations gave better results.

1. Water management

SRI needs less water than the conventional method but there must be an assured irrigation facility. Alternate wetting and drying (AWD) irrigation is one of the main recommendations of SRI. In the early stage of rice growth, it was recommended that the soil should be kept moist without stagnation of water on the field, and drying soil 3-4 times (up to the cracking stage) during the growing stage. This recommendation worked well on loose soils with high organic matter content. On heavy clay soils, the drying effect was found to have negative impacts. Heavy clay soils become very hard after drying, which is problematic for root growth. These results showed how the recommendations for water management of rice fields needed to be adjusted according to soil type—loose soils with rich organic matter can be dried up to the cracking stage but heavy clay soil should be kept moist for the better growth (root and shoot) of rice. Based on that reality and the farmer’s reactions, we changed our SRI recommendation of water management according to soil types after the third season.

2. Variety and spacing

Initially we recommended 25x25 cm or 30x30 cm spacing for all rice varieties in all soil types. Rice varieties used by SRI farmers in the early days had a long duration and high tillering capacity. The growth and development of currently used rice varieties were very good but expected output has not been achieved by other short duration and low tillering modern varieties. We observed that fertile tiller, panicle size and number of grains per panicle increased with wider spacing, but the total number of panicles per unit area was less in some varieties. That is, the expected production was decreased. The next season we conducted trials on different varieties and spacing on the farmers’ fields. The trial results demonstrated the appropriate adjustments required. Short duration varieties and some newly released varieties had reduced tillering habits and needed to be transplanted closer (20x20 cm) than previously recommended. The best results according to variety are given in Table 1. By this joint learning, we recommended three spacings 20x20, 25x25 and 30x30 cm according to rice variety and soil fertility status. This worked well, and farmers and extension workers became experts on adjusting spacings according to variety and soil.

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Rice variety</th>
<th>Crop duration (days)</th>
<th>Highest yield (t/ha)</th>
<th>Best spacing for greatest yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basdhan/Kanchi</td>
<td>145</td>
<td>11</td>
<td>25x25 cm</td>
</tr>
<tr>
<td>2</td>
<td>Mansuli</td>
<td>155</td>
<td>9.9</td>
<td>30x30 cm</td>
</tr>
<tr>
<td>3</td>
<td>Swarna</td>
<td>155</td>
<td>9</td>
<td>25x25 cm</td>
</tr>
<tr>
<td>4</td>
<td>Sugandha</td>
<td>120</td>
<td>7</td>
<td>20x20 cm</td>
</tr>
<tr>
<td>5</td>
<td>Radha 12</td>
<td>155</td>
<td>9.6</td>
<td>25x25 cm</td>
</tr>
<tr>
<td>6</td>
<td>Hardinath 1</td>
<td>120</td>
<td>8.4</td>
<td>20x20 cm</td>
</tr>
</tbody>
</table>

3. Weed management

Young seedlings, wider spacings and AWD irrigation create a favourable environment for weeds. Weed management is the one of the crucial tasks for the SRI method. Initially DADO recommended 3-4 manual weedings for SRI, but the labour requirements for this were more than doubled when compared to the conventional method. Farmers reported that it was difficult
to manage the increased labour for the larger SRI fields. To solve this problem, DADO introduced mechanical weeders (cono weeder—a two-wheeled rotary weeder) in 2005. Farmers tried it in different types of soil and situations. One important issue for mechanical weeding was the availability of water on the field to roll the weeder. Furthermore, most of the female labour force felt it was very difficult to roll the weeder on the field, and only male labourers used it in their fields. The rotary weeder cut down the labour requirement of SRI by three-quarters but its use was problematic, particularly because rice weeding is conventionally done by female labourers. Some farmers made their own weeders that were lightweight and easy to operate, (see Plates 1-4) and some maintained closer spacings (20x20 cm) to reduce weed growth. Other farmers used a combination of chemicals (herbicides) and manual weeding for better weed management. These adjustments were done in partnership with the farmers. Strategies were different on different farms and were influenced by water availability, soil type, labour type and labour availability. Based on our joint learning we suggested different weed management strategies for the SRI farmers according to their situations.

Plate 1 and 2. Farmer-made weeders
Plate 3 and 4. Farmer-made markers

Trends of SRI dissemination in Morang

In the beginning it was very difficult to convince farmers to change their conventional rice farming practices. Farmers did not believe in the survival of younger, delicate seedlings, and wider-spaced plantings scared them about not covering the total field with rice plants. Water management was another difficulty because traditionally they always held or flooded water on their fields. They were sceptical about the alternate wetting and drying system. Even after seeing the reality on the fields, it was very difficult for the farmers to believe. Slowly farmers and extension workers gained confidence in the SRI practices. After joint trials and learning, they felt more comfortable to communicate and interact with each other. Such interaction helped to modify and re-shape the general recommendations according to local situations. Such modifications to the technology have speed-up SRI dissemination in the later stages of the project. Figure 1 shows the growth of SRI in Morang. In addition to Morang, SRI was introduced
to more than 30 districts of Nepal. To disseminate SRI in the other districts, newspapers and television played a very important role. Most of the leading media, including the BBC World Service, reported on our SRI activities and performances (Haviland 2005; Dixit 2005).

**Fig 1. SRI dissemination trend in Morang district**

![Graph showing SRI dissemination trend in Morang district from 2003 to 2006.](image)

**Change in the attitude of extension workers and farmers**

Initially most of the extension workers thought they were a source of information and the farmers were passive recipients of technical information. They always tried to influence and dictate to the farmers about new technologies for change. When they started to work with farmers and saw first-hand some failures based on their own recommendations, they slowly started to re-think their information. Initially, they discussed the issues with other extension workers and subject matter specialists (SMS). They then went to the fields to begin a review with the farmers as farmers are always in the field and observe all the changes with their plants. This closeness gives the farmers greater knowledge about the plant and its development. Having the extension workers working together with the farmers was an important opportunity for joint learning. Through this joint effort they found out several new facts and learnt from each other. The farmers initially worked as passive recipients, but they slowly started to open up and present their experiences and thinking. When DADO started to incorporate their findings and suggestions, the farmers became pro-active to test and disseminate the new information and tools (Plate 1-4) and techniques. Both the extension workers and farmers considered each other as their partners to re-shape technology or invent new knowledge and to disseminate new technology like SRI. This is the main learning by the SRI dissemination project.

**Conclusion**

Participation of farmers in all steps of the SRI trials and demonstrations helped to reshape the technology. Joint work of extension workers and farmers in diversified farming and agro-ecological conditions encouraged modification of some of the SRI recommendations and practices. This lead to the repackaging of SRI according to soil type and other conditions, in particular rice varieties and farmer socio-economic situations. These modifications proved to have good results and SRI has been disseminated to several districts of the country. SRI appeared to catch-on in areas where the DADO had not been active in the past. These outcomes brought a change in the thinking of extension workers. They realised that joint learning benefited farmers, extension workers and researchers. These results emphasised that such partnerships and modifications can be helpful to increase technology acceptance, especially for those resource-poor farmers living far from modern agriculture development.

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Developing weed management best practice amongst lifestyle farmers

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Abstract. Lifestyle farmers have been identified as a poorly performing landholder segment with regard to weed management in Australia. However, despite their often non-economic land management goals, and the range of impediments they face, many lifestyle farmers are keen to improve their weed management skills. Our goal was therefore to produce and distribute a booklet on weed detection and control using best practice methods to lifestyle farmers, using information developed in recently completed University of New England research projects. An evaluation of literature and advice from weeds extension professionals across Australia guided the booklet design. Distribution of the booklet took place through existing extension networks. Nearly 10,000 printed copies were distributed free of charge during 2010, while a further 7,000 had been sold to weed extension organisations at the time of writing. This approach proved an efficient and cost-effective way to extend best practice weed detection and control to a difficult to reach audience.

Keywords. Lifestyle farmer, weed detection, weed control, extension booklet.

Background

Small farm owners (or ‘lifestyle farmers’) are responsible for the management of a large proportion of land in highly productive regions of rural Australia (Hollier et al. 2003). However, as recent research has shown (Sindel et al. 2008), Australian farmers and weeds inspectors alike consider lifestyle farmers of various types (hobbyists, absentee landholders and landholders with off-farm employment) to be less likely than professional farmers to inspect their land for weeds, and less likely to undertake effective weed control.

Lifestyle farmers are often relative newcomers to the land, and are considered to have inadequate knowledge of farm and environmental management and biosecurity issues, posing a potential risk to neighbouring commercial farms (Bowling 2007). Many professional landholders believe that neighbouring lifestyle farmers adopt ‘bizarre’ farming practices, some of which have negative environmental consequences or encourage weeds and pests. Different management practices and philosophies can create tension between professional landholders and their lifestyle-oriented neighbours (Hollier et al. 2004; Hollier and Reid 2007).

While all landholders face impediments to effective weed control, lifestyle farmers may be constrained by a number of specific factors (Low Choy and Harding 2008; Sindel et al. 2008). These include:

- lack of knowledge regarding weed identification and management practice
- belief that somebody else (such as a government department) is responsible for weed control on their land
- lack of time and labour due to off-farm employment
- different land management values to production landholders
- not appreciating the importance of weed control
- lack of appropriate equipment
- old age or ill health.

Weed management can have significant financial benefits for landholders. However, many lifestyle farmers are relatively unconcerned about farm profitability, given high off-farm income and the small area their land covers. Instead they tend to focus on the lifestyle benefits of rural living, and on other non-profit oriented goals such as habitat restoration, self-sufficiency, increasing land value or further subdivision, and participation in small-scale or niche agricultural production as a hobby (Hollier et al. 2004; Low Choy and Harding 2008). The lifestyle farming sector includes a diversity of land management practices, many of which are contrary to those used by farmers for whom the land is their livelihood. Weed management extension must address the needs of lifestyle farmers and professional farmers alike (Vanclay 2004).

The relatively poor weed control performance of lifestyle farmers as a group is a result of their particular constraints and priorities. However, Low Choy and Harding (2008) identified considerable potential for lifestyle farmers to improve their knowledge of weed spread, detection and control, as well as a latent desire to do so. In a survey of lifestyle farmers in NSW, they found that:
• many lifestyle farmers are committed to natural resource management (NRM) and participate in Landcare and other similar groups
• many had improved their knowledge of NRM, either through self-education or talking to others
• the most sought-after NRM information by lifestyle farmers was in relation to weed control
• most wanted to be able to do more to control weeds on their land.

Considerable information and assistance is available to all landholders on weed control, much of it free of charge. In addition to the numerous weed identification sources available in published form and online, Federal, State/Territory and local government, and local weeds inspection authorities, offer weed control fact sheets and brochures, or personal assistance.

While weed identification resources are useful for all landholders, much of this assistance is tailored to the needs of professional landholders. Few weed detection and control resources have been targeted specifically at lifestyle farmers and new landholders. We therefore decided to produce a booklet on weed management tailored to the needs of lifestyle farmers, including information on weed detection 'best practice', and simple to implement weed control methods. This booklet, ‘Weed Detection and Control on Small Farms’, was published in 2010 (Sindel and Coleman 2010).

**Extending best practice weed management to lifestyle farmers**

A literature review was conducted to guide the content and design of the booklet, and to identify possible avenues of distribution to lifestyle farmers. Based on the review (summarised above), we concluded that the booklet needed to emphasise effective weed control as a prerequisite to lifestyle farming goals such as habitat restoration, scenic preservation, niche industry production, and indeed acceptance in the local community. That is, weed control should not only be considered important for its economic benefits for producers.

It was also evident that certain integrated weed management approaches, involving diverse weed control methods, are more appropriate to professional farmers who have the necessary background and equipment to employ a complex strategy, and are able to do so on a large scale. The relative lack of land management experience of lifestyle farmers, and their time and resource limitations, meant the booklet needed to highlight *diligence* in checking for weeds and in controlling outbreaks using simple control methods. Where large weed outbreaks occur, owners of small blocks need to work with their neighbours to control the weed at a district level. By detecting and controlling weeds before they have had a chance to spread, lifestyle farmers can save time, labour and money in the longer term, allowing them to focus on the enjoyable aspects of living in rural Australia.

Lifestyle farmers have reported a general lack of farm management information specific to their needs, and many also believe that their educational requirements are considered secondary to those of professional farmers (Hollier and Reid 2007). Despite this, locally relevant information and support (particularly from weeds inspectors) is available for lifestyle farmers who want to find out more about weed control. Therefore, the booklet needed to highlight existing sources of information on local weed threats, for example who to speak to locally for advice, and where to obtain information on specific species. It was considered particularly important to emphasise the role that local weeds inspectors can play. Lifestyle farmers should consider inspectors as an important resource, rather than a ‘threatening’ figure with the power to prosecute poor weed management.

Preferred sources of farm management information for lifestyle farmers are varied, and include free booklets and fact sheets, magazines and newspapers, neighbours and local Landcare groups, and rural-oriented organisations and businesses such as government agencies and extension practitioners, stock and station agents, and rural merchandise stores (Hollier and Reid 2007; Low Choy and Harding 2008). Like the farming community more broadly, extension will be most effective in reaching lifestyle farmers if a range of methods are adopted (Vanclay 2004). Although a best practice weed detection booklet is only one way in which weed management practice amongst the lifestyle farming sector may be improved, we believed its effectiveness and potential reach could be broadened by distribution through existing extension networks likely to reach lifestyle farmers.

We therefore considered a range of potential distribution avenues for the booklet (which was provided free of charge). This included providing copies of the booklet, or advising its availability, to organisations and individuals likely to come into regular contact with lifestyle farmers, including weeds inspectors and local government, district agronomists, natural resource management organisations and Landcare groups, and rural merchandise outlets. The
booklet could also be promoted through mainstream rural media or targeted small farming magazines, as well as on the internet. Small farm field days are also an important way to reach lifestyle farmers, though this option was outside the scope of our project budget.

**Booklet content**

The booklet was written to provide a general introduction to weed detection and control responsibilities and methods suitable to lifestyle farm owners, as well as some issues to be considered in relation to weed control. Input was sought from several weeds experts across Australia, to ensure the booklet offered practical advice suitable to inexperienced lifestyle farm owners who may be having difficulty with weed management.

*Plate 1. Front cover of ‘Weed Detection and Control on Small Farms’*

‘Weed Detection and Control on Small Farms’ begins by outlining the impact of weeds on Australian agriculture and the benefits of weed control for lifestyle farmers, defines weeds, and explains how they spread. The booklet then explains some of the ‘best practice’ principles for weed detection on Australian farms. Much of this information on weed detection best practice was developed from a recent LWA-funded project (Sindel et al. 2008), in which we sought to identify best practice weed detection methods used on Australian farms by surveying weeds inspectors and landholders. These best practice principles include where (e.g. vulnerable or high-risk areas on the farm) and when (e.g. time of year) to look for weeds, how to identify an unknown plant, and what to do when finding a new weed outbreak.

The booklet also discusses aspects of weed control on small farms, including the weed control responsibilities of owners, guidelines for responsible use of herbicides and chemical accreditation, personal and financial assistance available to owners, and how to control large-scale and cross-boundary weed outbreaks. Specific weed control and spread minimisation methods are discussed, including good farm hygiene, digging and pulling weeds out, slashing and mowing, promoting desirable plants to out-compete weeds, grazing techniques, mulching, and using selective and non-selective herbicides.

Where more specific localised information is required, the booklet suggests that lifestyle farmers contact their local weeds inspector in the first instance. State/Territory-level contact details are provided, and a range of references and useful weed identification resources listed. Many of these resources are freely available to all landholders. The varied geographic and climatic circumstances of Australian lifestyle farms, variety of weed species, and legislative differences across Australia, made it impractical to include specific localised details in a small publication.

**Distribution**

Ten thousand copies of the booklet were printed initially. Distribution involved sending a single copy to participants in two recently completed University of New England weed research projects. Recipients included landholders, weeds inspectors and extension officers, those involved in weed research, and employees of natural resource management bodies and various State and Territory departments of primary industry (or similar).

Recipients were encouraged to request additional booklets to distribute to lifestyle farmers, and to advise colleagues who may be interested in obtaining copies. Relevant organisations and professional bodies, including natural resource management organisations, Landcare, various state-level weeds societies, and State/Territory departments with a role in weed management, were also advised either by email or telephone of the booklet’s availability, and encouraged to order and distribute copies to landholders. The booklet was promoted to weeds professionals in
NSW through the Weeds Extranet and email news service operated by Industry & Investment NSW. Several organisations took it upon themselves to promote the booklet’s availability in their member newsletters, or on their web sites. A free downloadable PDF copy was made available through the University of New England web site.

Using this approach, nearly all of the 10,000 copies had been distributed within three months of the booklet’s publication, and all had been distributed by late 2010. As a result, we decided it was not necessary to pursue other possible extension avenues, such as rural media, stock and station agencies, and rural merchandise stores.

Further requests meant that a reprint was carried out in 2011. Due to lack of project funds, reprinted booklets were offered at a small cost per booklet to cover printing and postage. In addition to additional requests, an email was sent to those who had earlier requested and received free copies of the booklet, advising them that booklets were once more available. At the time of writing, nearly 7,000 additional copies of the booklet had been sold to extension agencies and organisations.

The distribution method proved to be a cost-effective way to extend weed detection and control best practice to lifestyle farmers, a landholder segment that can be difficult to identify, particularly on a national scale. In most cases, bulk orders were sent out to individuals in direct regular contact with lifestyle farmers. Booklets were distributed to landholders during routine weeds inspection work, placed on display, distributed as part of information kits for new landholders, distributed at workshops and short courses, and handed out to agricultural and small farm field day attendees.

**Discussion**

Recent research has identified a need for lifestyle farmers in Australia to improve their weed management practices. While weeds inspectors and landholders alike (including lifestyle farmers themselves) consider this group to be relatively poor weed managers, there is a desire amongst many lifestyle farmers to improve their knowledge of weeds and weed management. Lifestyle farming is becoming increasingly popular in peri-urban, high growth and many highly productive regions in rural Australia, and so it is important to ensure that owners are well equipped to manage weeds on their land.

Despite this, much of the freely available information on weed management has been targeted at professional farmers, both in terms of content and extension approach. It was therefore decided to summarise best practice weed detection strategies identified in our research, as well as simple to use weed control methods, into a booklet targeted specifically at the small farm owner. Using existing extension networks, we promoted and distributed approximately 10,000 copies of the booklet, ensuring that copies were channelled through to the target landholder group to encourage adoption of best practice weed management.

Weeds professionals who requested and received copies of the booklet were generally positive about the content. Many were already trying to do more to educate lifestyle farmers about their weed control responsibilities, and saw the booklet as a useful resource in their efforts. A new publication designed to reach a group of landholders who were considered poor performing weed managers was welcomed, and weeds professionals were happy to distribute the booklet on our behalf. This method, through which the large majority of booklets were distributed, proved efficient and cost-effective. It was also a good way to extend best practice methodology to an otherwise difficult to reach landholder segment, often at a moment when landholders are discussing weed management with an expert (for example, at a workshop, or during an on-farm visit or one-to-one extension activity).

We acknowledge that a guide booklet on weed management aimed at lifestyle farmers is not enough on its own to improve practices, given the diverse land management goals and social contexts of lifestyle farming in Australia. Distribution of this booklet needs to be coupled with other extension methods such as media promotion, farm visits and field days (Vanclay 2004). Nonetheless, our experience during this project suggests that extension workers may need to consider the following when trying to reach the lifestyle farmer segment with printed or online information on farm management:

- Extension documents need to account for the variety of lifestyle farming practices, and their divergent goals (many of which are non-economic in nature), and to emphasise how changes in practice will help achieve these goals.
- The information needs to be distinguishable from that designed to meet the needs of professional farmers, and tap into the desire of many lifestyle farmers to educate themselves on farm management approaches appropriate to their scale and priorities.
• Lifestyle farmers can be difficult to reach for extension purposes, particularly when the goal is to educate farmers at a state or national scale.
• The most effective way to reach lifestyle farmers is through existing extension networks that may have a role in educating this landholder segment at a local level (in our case this included weeds inspectors, Landcare and NRM groups and government agencies, but appropriate networks may vary depending on the type of farm management information being promoted).

While not used directly in this project due to budget constraints, small farm and general rural field days are another important avenue of extension to lifestyle farmers. Some weeds professionals did request booklets to distribute at field days. In NSW alone, a number of such field days are readily identifiable, including Ag Quip in Gunnedah, the Tocal Field Days, the Mudgee Small Farm Field Days, and the Farming Small Areas Expo in outer western Sydney.

Although the hard copy booklet has proven very popular (both as a free product in the first print run, and at a small cost to extension agencies and organisations upon reprint), a freely downloadable version of the booklet will remain available on the internet once all hard copies have been distributed.

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