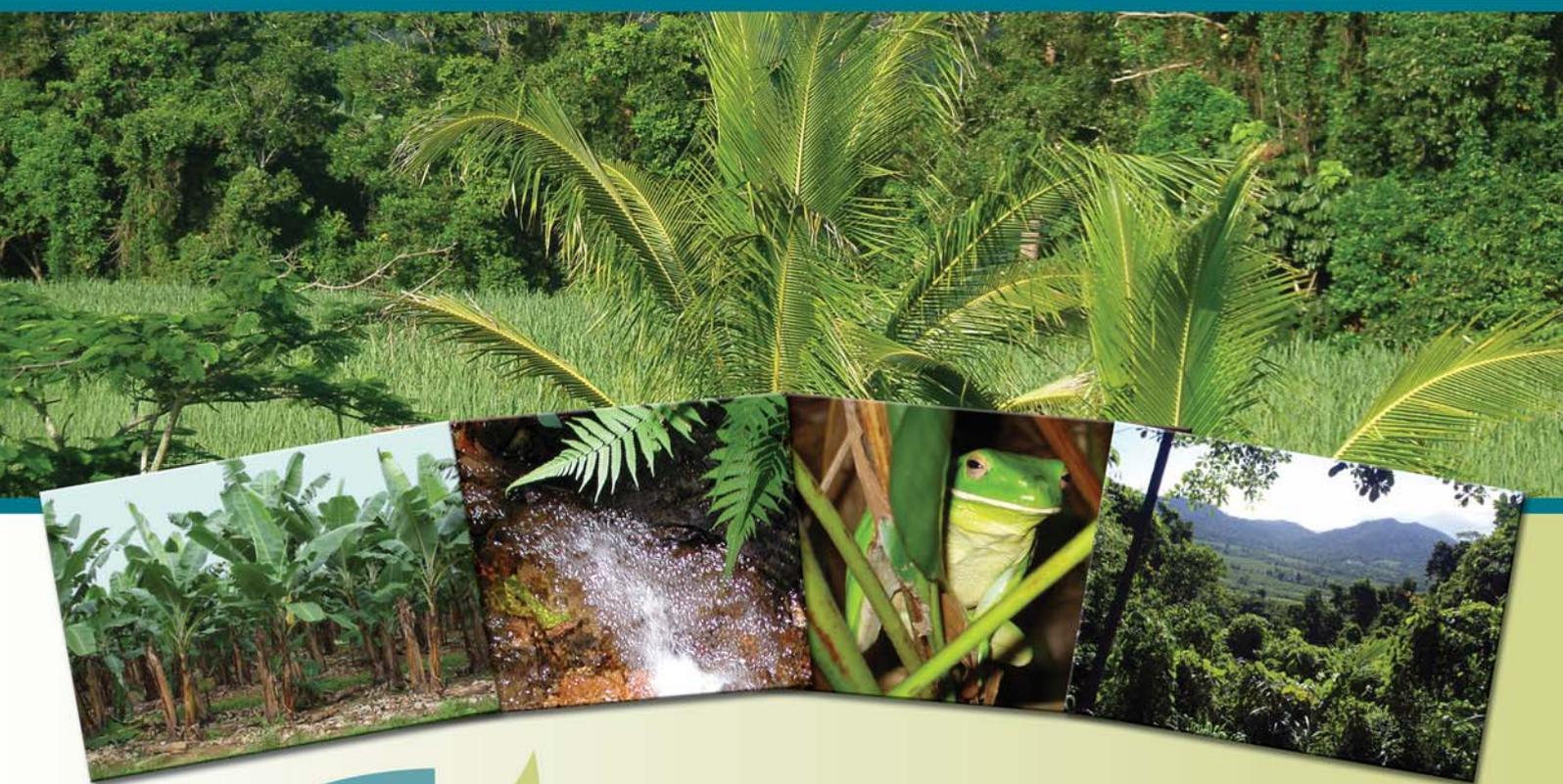




# Market segmentation study of rural landholders in relation to the promotion of natural resource management on private land in the Wet Tropics region of Queensland



Nick Emtage





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**Australian Government**

**Department of the Environment,  
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## Acronyms Used In This Report

<b>CRP</b> .....	Currently recommended practice
<b>EMS</b> .....	Environmental management system
<b>GPS</b> .....	Global positioning system
<b>NRM</b> .....	Natural Resource Management
<b>P&amp;C</b> .....	Parent and citizens (e.g. School P&C Association)
<b>RSE</b> .....	Relative standard error
<b>WTWHA</b> .....	Wet Tropics World Heritage Area

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## Executive Summary

This report describes a series of community sector or group profiles with varying levels of interest and engagement in natural resource management (NRM) activities, based on responses to a survey of rural landholders in the Wet Tropics NRM region of far northern Queensland. Indices were developed to represent landholders' interest in and concern about NRM issues and to represent their level of engagement with (i.e. adoption of) currently recommended practices (CRPs).

Indices were used to undertake a cluster analysis of survey responses, resulting in the identification of five groups ranging from the 'well-connected and progressive' landholders (10% of the sample), who are highly motivated and engaged in using CRPs, to the 'concerned but unengaged' (20%), who are interested but not engaged in CRPs. Other groups include the 'multiple objectives group' (20%) who are moderately interested and engaged in the use of CRPs, the 'production orientated' landholders who are engaged in the use of CRPs but not greatly concerned about NRM issues (10%), and the 'disconnected and conservative' landholders (40%), who have low levels of interest in or engagement with NRM activities.

Profiles of the five groups were developed through examining the characteristics and differences in group members' properties and land uses, their management goals, trust in others, communication behaviour and management behaviour. The final section of this report presents recommendations for tailoring programs to help meet the objectives described in the Wet Tropics Regional NRM Plan (FNQ NRM Ltd and Rainforest CRC 2004).

Three of the five groups were predominantly composed of members whose primary purpose for property management is agricultural production (the 'multiple objective', 'production orientated' and 'well-connected and progressive' groups). Members of these groups had moderate to high levels of adoption of both enterprise related CRPs and those that could potentially apply to any rural property. The members of the 'well-connected and progressive' group are characterised by their strong interest in NRM issues together with a strong interest in building their businesses. They rated all information sources as useful to inform their management decisions and typically regularly attend meetings of several social groups including Landcare groups, industry groups and NRM groups. This group appears to have an 'information rich' decision making style and high level of integration in social networks that makes them relatively easy to communicate with in relation to CRPs. The 'production orientated' landholders are strongly motivated to build their enterprises but have relatively low levels of concern about NRM issues. These landholders find information from 'productivity' sources most useful, are typically members of 'industry' groups and most have attended short training courses related to land management. Members of this group are likely to be best supported and encouraged to continue development of their management practices through continued support of industry led training courses and information programs. Members of the 'multiple objectives' group have moderate levels of adoption of CRPs. They are equally motivated to manage their property for commercial, environmental and social outcomes. They are most interested in vegetation management and have adopted a number of recommended vegetation management practices but are less likely to have adopted industry-based CRPs than members of the other two 'agriculture dominated' groups.

Approximately half the members of the two remaining groups did not undertake commercial-scale agricultural enterprises. Members of the 'concerned but unengaged' group were concerned about NRM issues and engaged in vegetation management practices but not other recommended practices such as property planning or short course attendance. Members of this group were less involved in social groups relating to agriculture and land management than those in the three groups dominated by landholders involved in

agriculture. The high level of interest in improving the environment means that members of the 'concerned but unengaged' group could be expected to take up CRPs relatively quickly, yet their lack of identification with industry groups and lack of time means they would need to be targeted with different education and support programs than those for 'full-time' farmers.

The final group was termed the 'disconnected and conservative' landholders. This group comprised forty percent of the total sample, half of whom are involved in agriculture. They had the lowest levels of interest in NRM matters and lowest rates of adoption of CRPs. Members of this group are characterised by the low levels of importance they attach to any property goals, the low ratings of usefulness for any information sources, low levels of participation in industry or environment based social groups and relatively low levels of trust for other people and institutions in the region. With low levels of concern about NRM issues and a lack of motivation to improve management practices for commercial or environmental purposes, the members of this group appear unlikely to adopt many CRPs. The first step to encouraging these landholders to improve their practices requires first convincing them of the need to address NRM problems.



## Introduction

Traditional marketing is designed to increase the sale or consumption of particular commercial goods and services. *Social marketing* is a term used to describe the process of promoting the adoption of behaviours that improve social well-being (Kotler and Lee 2008). Social marketing has already been applied in a range of health promotion programs including anti-smoking campaigns and programs to encourage safe sexual practices. It has also been used by the Landcare movement to promote adoption of improved NRM practices (Australian Public Service Commission 2007).

Social marketing practitioners apply many of the principles and techniques used for 'traditional' marketing, seeking to benefit from the enormous investments that have been made in market research by private companies. This involves identifying the 'product' (which could include a combination of behaviour, awareness or belief changes) that is to be developed, identifying target markets, developing an understanding of the target markets, developing promotion strategies and more. A summary of the recommended process to apply a social marketing assessment is provided in Appendix A. The first two steps in this process entail developing a focus for the project then undertaking a situation or background analysis. These steps have been completed with the development of the Wet Tropics Regional NRM Plan and background reports (FNQ NRM Ltd and Rainforest CRC 2004; McDonald and Weston 2004; Weston and Goosem 2004; Armour *et al.* 2004). The third step in the process is to undertake a market structure analysis which is the focus of this report.

This report presents a 'market structure' analysis of rural landholders in relation to NRM on private lands in the Wet Tropics NRM region of Queensland, Australia, using data gathered in a postal-based survey of private rural landholders in the Wet Tropics NRM region of far northern Queensland<sup>1</sup>. The technique of 'market segmentation' is used to identify sectors or groups of people within the community with similar behaviour and attitudes toward the subject of concern (i.e. clustering the respondents into groups that are relatively internally homogenous and different from each other).

The next step is profiling these groups' behaviour, levels of interest in and awareness about the topic as well as their socioeconomic circumstances and personal value systems. The main focus of this report is to define and describe a series of profiles of landholder 'market segments' in relation to NRM for the Wet Tropics region. Following the presentation of the profiles some preliminary recommendations are made regarding the implications of the findings for the development of targeted policies and programs. Some background to the factors affecting these recommendations is provided below.

Undertaking a market segmentation analysis is seen as critical to developing any effective marketing strategy in the commercial world (Dillon *et al.* 1990). There are three basic approaches that can be taken to marketing desired changes in awareness, attitudes and behaviour (Kotler and Lee 2008). These include:

- Undifferentiated marketing, in which the same strategy is applied to the whole community;
- Differentiated marketing, where different strategies are developed for differing audiences or groups; and

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<sup>1</sup> A description of the methods and responses to the survey of rural landholders in the Wet Tropics NRM region is provided in Emtage and Reghenzani (2008). A second report describes the results of a series of principal components (factor) analyses together with profiles of the landholders segmented according to their primary land use and area of their landholding (Emtage and Herbohn 2008).

- Concentrated marketing, whereby some sectors of the community are identified and described and resources are devoted to developing key strategies for selected sectors in the community.

Without a market structure analysis or some form of segmentation of the community, only undifferentiated marketing strategies are possible. Kotler and Lee (2008: 117) argue that using market segmentation provides a number of advantages, including increased effectiveness (i.e. increased adoption of desired behaviours, increased awareness about a topic and changed beliefs), increased efficiencies, a guide for resource allocation and a guide for developing strategies<sup>2</sup>.

There are a number of ethical issues to be considered when developing strategies to change peoples' awareness, attitudes and behaviour. One argument for applying concentrated marketing is that agencies which seek to promote 'social good' behaviours operate within tight budgets and need to carefully target their use of funds in order to be effective. In the interests of equity it could alternatively be argued that when public funds are being spent, the agencies involved should seek to address the positions of all sectors of the community. A number of criteria have been proposed for use in evaluating which sectors or segments to target when developing social marketing assessments (Andreasen 1995). These criteria include the:

- Segment size (proportion of people in the segment);
- Problem incidence (proportion of people who are not undertaking desired behaviour);
- Problem severity (consequence of undesired behaviour by the segment);
- Defencelessness (ability of the segment to look after themselves);
- Reachability (ease with which segment can be communicated with);
- General responsiveness (how ready, willing and able the segment is to respond);
- Incremental costs (how difficult or expensive the segment is to reach);
- Responsiveness to marketing mix (how responsive the segment is likely to be to a particular marketing mix); and
- Organisational capacities (how experienced and resourced the organisation's capacity is to assist this segment).

A preliminary assessment of the groups identified in this report according to these criteria is presented in Appendix B. Ultimately the way that a market structure analysis is interpreted and applied in the development of programs and policies is decided by those that administer the programs.

### *Use of market segmentation and prime prospect analysis*

The current research project is being undertaken to assist with the design and delivery of NRM programs and policies. Many of the current programs and policies are based on the development of 'best practices' (referred to in this report as 'currently recommended practices' or CRPs) and targets, expressed in terms of the proportion of landholders that will have adopted those practices within a certain timeframe. For the purposes of developing a marketing strategy it is useful to better understand how the adoption of CRPs varies between different sectors of the community, how this relates to their interest in the topic, and whether these differences are related to varying communication behaviours, beliefs, values and socio-economic circumstances.

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<sup>2</sup> See Emtage *et al.* 2006 for a review of research projects that have applied segmentation processes to survey data relating to NRM in Australia.

There is an increasing awareness and acceptance that NRM is fundamentally about people management and communication (see for example Cary *et al.* 2001, 2002; Vanclay 2004). Many researchers and NRM practitioners are now recognising the value of improved understanding of the diversity of rural landholders to better target NRM and agriculture development policies and programs in Australia and New Zealand<sup>3</sup> (Chamala *et al.* 1980; Byron and Boutland 1987; Chamala 1987; Kaine and Lees 1994; van den Ban and Hawkins 1996; Howden *et al.* 1998; Specht and Emtage 1998; Emtage and Specht 1998a, 1998b, 1999; Guerin 1999; Black *et al.* 2000; Fulton and Race 2001; Howden and Vanclay 2000; Crase and Mayberry 2002; Emtage *et al.* 2001; Jennings and van Putten 2006; Kaine and Beswell 2002; Bohnet 2004; Bohnet *et al.* 2007; Kaine and Higson 2006; Morrison *et al.* 2008) and elsewhere (Kostrowicki 1977; Raintree 1987, 1991; van der Ploeg 1993; Landais 1998; Johnson 2002; AAFC 2002; O'Keefe *et al.* 2002; Kobrich *et al.* 2003; Boon *et al.* 2004; Wiersum *et al.* 2005; Butler *et al.* 2007; Selter *et al.* 2009; Van Herzele and Van Gossum, 2008).

Undertaking a market segmentation analysis is seen as critical to developing any effective marketing strategy in the commercial world (e.g. Dillon *et al.* 1990). Kotler and Lee (2008: 117) argue that using market segmentation to aid programs designed to improve social welfare or the biophysical environment provides a number of advantages, including increased effectiveness (i.e. increased adoption of desired behaviours, increased awareness about a topic and changed beliefs) and increased efficiencies through provision of information with which to develop strategies and allocate scarce resources. Social marketing has already been applied in a range of health promotion programs and has been used by the Landcare movement to promote adoption of improved NRM practices (Mackenzie-Mohr and Smith 1999; Australian Public Service Commission 2007; Kotler and Lee 2008). To develop a strategy to promote the adoption of CRPs it is useful to better understand how their adoption varies between different sectors of the community, how this adoption relates to landholders' concerns about NRM issues, and whether these differences are related to variations in landholders' communication behaviour, beliefs, management objectives and socio-economic circumstances.

The research project reported in this paper was undertaken to assist with the design and delivery of NRM programs and policies in the Wet Tropics region of Queensland, Australia.

### *Ways to identify 'segments' in the landholder community*

Various methods have been used to define and describe segments in the community of rural landholders as discussed by Whatmore (1994) and Emtage and others (2006, 2007). These range from qualitative assessments based on landholders and expert appraisals of the segments (e.g. Howden *et al.* 1998; Busck 2002; Bohnet 2004; Bohnet *et al.* 2007; Vanclay 2005; Maller *et al.* 2008), to quantitative techniques based on surveys (e.g. Specht and Emtage 1998; Emtage *et al.* 2001; Kobrich *et al.* 2003; Wiersum *et al.* 2005; Johnson 2002; Jennings and van Putten 2006; Butler *et al.* 2007; Cummins *et al.* 2007; Kuehne *et al.* 2007; Selter *et al.* 2009) and those based on 'mixed' methods combining qualitative and quantitative data (Kostrowicki 1977; Escobar and Berdegue 1990; Barr 1996; Karpinnen 1998; Landais 1998; Ziegenspeck *et al.* 2004; Morrison *et al.* 2008; Morse-McNabb *et al.* 2008; Van Herzele and Van Gossum 2008), with profiles of the groups then developed based on assessments of the socio-economic and demographic characteristics and differences of each of the groups.

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<sup>3</sup> See Emtage *et al.* 2006 for a review of research projects that have used this approach in relation to NRM in Australia.

Various criteria have been used to define or cluster landholders into groups. Landholders' property management goals or objectives (a type of psychographic variable) have been used as the sole basis for clustering landholders in a number of studies (e.g. Kuuluvainen *et al.* 1996; Boon *et al.* 2004; Jennings and Van Putten 2006). In other cases a variety of criteria were used to define groups of landholders, including a combination of structural, financial, geographic and biophysical data (Landais 1998; Emtage and Suh 2005; Selter *et al.* 2009). It is well accepted that landholders' management values have some influence over their behaviour (Gasson 1973; Fairweather and Keating 1994; Cary *et al.* 2001, 2002; Crase and Mayberry 2002; Mayberry *et al.* 2005; Marshall 2008), yet there are many other factors that also influence their behaviour (Cary *et al.* 2001, 2002; Rogers 2003; Pannell *et al.* 2006). Emtage and others (2007: 487) concluded that land management values as the sole criterion for defining landholder types were not sufficiently discriminating to produce the most effective typologies for assisting the development and implementation of NRM programs. Selter and others (2009) compared the utility of using various criteria for defining typologies of landholders in relation to small-scale forest ownership, concluding that '... multivariate cluster analysis is at present the undisputed benchmark for all other approaches to developing typologies.' (Selter *et al.* 2009: 40). Ajzen (1991) concluded that the old axiom that the best predictor of a landholders' future behaviour is their past behaviour is true where conditions in which the behaviour takes place are largely unchanged. Landholders' past behaviour and level of interest in various possible goals for forest management, forms of psychographic and behavioural variables as defined by Kotler and Lee (2008: 120), were used to develop a landholder typology with the aim of improving forest management by non-industrial or 'family' forest owners in the United States (Butler *et al.* 2007).

Butler and others (2007) categorised landholders according to their level of engagement and level of interest in desired behaviours. The theoretical basis for using interest or concern about environmental issues and previous behaviour as criteria for defining landholder types relates to an understanding of the manner by which people change their behaviour (Prochaska and DiClemente 1994; Guerin 1999; Cary *et al.* 2001, 2002; Rogers 1988, 2003; Pannell *et al.* 2006; Kotler and Lee 2008). Behaviour change can be described as a multi-stage process, starting from a state of non-awareness of any problems or issue with the behaviour ('pre-contemplation'), through contemplation (becoming aware of a problem), preparation, action and maintenance, through to the 'termination' stage by which time this behaviour has become normal and accepted by the individual else has been deemed not appropriate or useful and discontinued. Previous research has indicated that the relationships between attitudes to environmental management and the adoption of behaviours thought to improve the environment are not simple and are influenced by a range of other factors that act as incentives or disincentives to adoption (Cary *et al.* 2001). Improved understanding of what has motivated some landholders to adopt CRPs, and the barriers to their adoption perceived by others, could help to improve policies and programs designed to promote their adoption and also provide some insight into the influence of attitudes to the environment relative to other factors.

In the following section the construction of the various indices to represent landholders' interest and engagement in NRM based on responses to the Wet Tropics Sustainable Agriculture survey (Emtage and Reghenzani 2008) is described. The third section of the report describes the results of the cluster analysis to define groups of landholders with similar levels of interest and engagement in NRM activities. The results of testing for differences in socio-economic characteristics, management practices and management values between the groups are then presented and profiles of each group developed. The final section presents a discussion of the characteristics of the groups and general strategies that could be used to improve the targeting of policies and programs designed to support adoption of CRPs.

## Data and methods used to undertake survey analyses

The data used to undertake the analysis was gathered using a postal survey of rural landholders in the Wet Tropics NRM region of far northern Queensland.

A total of 1,600 questionnaires were sent by post to a random selection of rural landholders with landholdings greater than two hectares. After a series of follow-up letters a total of 321 responses were received representing a valid response rate (less surveys returned due to 'unknown' or 'wrong address') of 21%.

Topics included in the survey and the items within each of the topics were as follows:

- **Characteristics of landholders and their holdings:**
  - Age; education; time on property, in district and on rural properties; involvement in community organisations; main occupation; time spent on property work per week; reliance on property income; number of dependents; off- and on-farm income levels; equity levels.
  - Size of landholding; number of titles owned; distance from residence; types and extent of various land uses; types and extent of native vegetation.
- **Perception of importance of NRM issues on own property:**
  - Perceived importance of eighteen potential NRM issues.
- **Perception of rural development issues regionally:**
  - Perceived importance of rural development issues.
  - View on neighbours' management activities and sustainability issues.
- **Goals for property management:**
  - Importance attached to various potential management objectives.
- **Property planning:**
  - Whether landholder has property management plan;
  - Whether landholder has environmental or farm management system; and
  - Likelihood of various strategies (i.e. to sell, lease, diversify, scale-back, etc.).
- **Trust in local organisations:**
  - Perceived trustworthiness of various government and non-government agencies.
- **Use of information sources and training:**
  - Perceived usefulness of 22 potential sources of information to aid property management.
  - Training: attendance, types attended and training sought.
- **Native vegetation management:**
  - Areas of various types of vegetation owned.
  - Whether landholders have encouraged, cleared or fenced native vegetation areas.
  - Perception of various reasons for and constraints to vegetation management.
  - Current management practices (with respect to eight proposed activities).
- **Livestock enterprises:**
  - Stock numbers and types.
  - Adoption of CRPs.
  - Perception of the appropriateness of CRPs.
  - Whether landholder uses potential new CRPs; extent to which they match property goals and resources; whether landholder will continue or adopt their use.

- **Cropping enterprises:**
  - Crop types and areas.
  - Fertiliser application rates.
  - Adoption of CRPs regarding crop establishment, harvest and irrigation.
  - Perception of the appropriateness of CRPs.
  - Whether landholder uses potential new CRPs; extent to which they match property goals and resources; whether landholder will continue or adopt their use.
- **Pest and weed management:**
  - Labour and money spent controlling non-crop pests and weeds.

A description of the responses to the survey and survey methods are provided in Emtage and Reghenzani (2008). A second report describes the results of a series of factor (principal components) analyses of topics within the survey as well as a series of landholder profiles based on the principal reason for landownership, the main land uses and the scale of operations of the landholder (Emtage and Herbohn 2008). The principal components analyses were used to identify factors underlying responses and to create a series of scales to represent these factors in subsequent analyses. These scales were used to represent the dimensions underlying responses to the following topics:

- Perception of importance of NRM issues on own property;
- Perception of rural development issues regionally;
- Goals for property management;
- Property management intentions;
- Use of information sources;
- Trust in local organisations; and
- Perceptions of native vegetation management issues.

The procedures used to undertake the market structure analyses were as follows<sup>4</sup>. First, indices were constructed to represent interest and engagement in NRM issues and practices for all respondents, and a series of indices were constructed to represent interest and engagement in cropping, grazing and vegetation management for landholders who reported having these land uses. Following construction of the indices, the 'interest' and 'engagement' indices were standardised (using *Z* scores where the mean is zero and the standard deviation equals one) so that the higher possible scores for the 'interest' index (out of six) did not dominate the scores for the engagement index (out of four) in the cluster analysis, i.e. to ensure they both carried equal weight in the cluster analysis.

The K-means cluster analysis technique was used to identify groups of respondents with similar levels of interest and engagement in NRM issues and practices. The indices used were those that related to 'all' respondents so as not to bias results against those not involved in agriculture or without native vegetation (i.e. the cluster analysis did not include the indices relating to vegetation, crop or grazing management). Two solutions from the cluster analysis were compared (one with four and the other with five groups). Differences between the groups from the two cluster analyses were assessed using a series of statistical tests and the five group solution selected for further investigation. Chi square tests (assessed with the Pearsons' statistic) were used to identify difference between the groups in respect to categorical (nominal) variables, and one-way ANOVA tests were used to identify differences between the groups in respect to continuous (ordinal) variables. The level of significance used to determine whether differences were 'significant' was the 95% confidence level for all

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<sup>4</sup> All analyses were undertaken using the SPSS software program (version 14.0).

tests. Where one-way ANOVA tests were found to indicate significant differences, post-hoc tests (Bonferroni method) were used to identify the source of the differences (i.e. which groups differed from each other). Where the homogeneity of variance differed significantly between the groups, Tahmane tests were used as these do not require homogenous variance within groups.

## Indices to represent interest and engagement in NRM

Given that rural landholders in the Wet Tropics are involved in a number of different industries (e.g. cropping, grazing and the management of native vegetation) and have varied land use types, the challenge in undertaking this analysis is to devise indices from the survey responses to represent the 'engagement' and 'interest' in a way that is appropriate for those involved in different land use activities. To achieve this, indices were computed to measure the interest and engagement of landholders in activities that apply to all landholders (such as the preparation of property management plans and participation in government NRM programs). These indices were used as the basis for segmenting the sample using K-Means cluster analyses. Separate indices have been calculated to represent interest and engagement in NRM activities specific to native vegetation management and the cropping and grazing industries. Index scores were calculated as the sum of the scores of items used in each index as described below. The variable name and scores for each item within the indices are indicated.

To measure engagement (i.e. the current adoption of CRPs and level of activity), the following variables from the survey were used:

- If have property plan (1 if have plan; 0.5 if in progress; 0 otherwise);
- If have an environmental or farm management system (1 if have EMS; 0 otherwise);
- If participated in government NRM program in last five years (1 if have participated; 0 otherwise); and
- If participated in short course (1 if have participated; 0 otherwise).

These CRPs were used to create the 'engagement' index because they could apply across industry types and because some included the use of property plans (Cary *et al.* 2001; Byron *et al.* 2006a, 2006b) and training courses (Kilpatrick *et al.* 1999; Black 2000; Cary *et al.* 2001; Pannell *et al.* 2006) have been reported to have strong relationship with adoption of CRPs.

### **Variables of engagement for landholders with areas of native vegetation:**

- If have encouraged regrowth of vegetation (EngEncVeg = 1 if have encouraged vegetation; 0 otherwise);
- Whether fenced areas of native vegetation (EngFenceVeg = 1 if have fenced vegetation; 0 otherwise);
- Whether have remnant map (EngMapVeg = 1 if have map of vegetation; 0 otherwise);
- If gather NTFPs (EngNTFPVeg = 1 if have gather NTFPs; 0 otherwise);
- If use native vegetation area for recreation? (EngRecVeg = 1 if have use for recreation; 0 otherwise);
- If use for timber (EngTimbVeg = 1 if use for timber; 0 otherwise);
- If undertake pruning (EngPrunVeg = 1 if have pruned vegetation; 0 otherwise); and
- If undertake thinning (EngThinVeg = 1 if have thinned vegetation; 0 otherwise).

### **Variables of engagement for landholders with grazing activities:**

- If fence waterways (EngFenWatGraz = 1 if have fenced stock from waterways; 0.5 if partly adopted; 0 otherwise);

- If fence vegetation areas (EngFenVegGraz = 1 if have fenced stock from native vegetation; 0.5 if partly adopted; 0 otherwise);
- If use controlled grazing (EngContGraz = 1 if have adopted controlled grazing; 0.5 if partly adopted; 0 otherwise);
- If use soil testing for nutrients (EngSoilTestGraz = 1 if have adopted soil testing; 0.5 if partly adopted; 0 otherwise);
- If quarantine new stock (EngQuarStckGraz = 1 if have adopted new stock quarantine; 0.5 if partly adopted; 0 otherwise);
- If use feedlots (EngFeedlotGraz = 1 if have adopted use of feedlots to ease grazing pressure; 0.5 if partly adopted; 0 otherwise);
- If recycled effluent (EngRecEfflGraz);
- Laser fencing (EngLaserGraz = 1 if have adopted laser fencing; 0.5 if partly adopted; 0 otherwise);
- Improved pasture (EngImpPastGraz = 1 if have adopted use of approved pasture; 0.5 if partly adopted; 0 otherwise); and
- Slow release fertilisers (EngSlowFertGraz = 1 if have adopted use of slow release fertiliser; 0.5 if partly adopted; 0 otherwise).

#### **Variables of engagement for landholders with cropping activities:**

- Minimum tillage (EngMinTilCrop = 1 if have adopted minimum tillage; 0.5 if partly adopted; 0 otherwise);
- Soil testing (EngSoilTestCrop = 1 if have adopted soil testing; 0.5 if partly adopted; 0 otherwise);
- Legumes (EngLegCrop = 1 if have adopted legume rotations; 0.5 if partly adopted; 0 otherwise);
- Stubble retention (EngStubRetCrop = 1 if have adopted stubble retention; 0.5 if partly adopted; 0 otherwise);
- Grass headlands (EngGrassHeadCrop = 1 if have adopted grass headlands; 0.5 if partly adopted; 0 otherwise);
- Earthworks (EngEarthWrkCrop = 1 if have adopted earthworks to control soil movement; 0.5 if partly adopted; 0 otherwise);
- Lime/gypsum application (EngLimeCrop = 1 if have adopted lime or gypsum application; 0.5 if partly adopted; 0 otherwise); and
- Irrigation practices not assessed.

#### ***Indices to represent interest in or attitudes to NRM***

Indices were constructed to represent landholders' interest in NRM issues. These indices were based on responses to questions related to attitudes to management issues, management goals, information use and trust in organisations. The cut-off points for each item were determined after examining the distribution of responses. Where there was a reasonably normal pattern distribution, the cut-off score was selected to identify the top 10-50% scores (by allocating a score of one) to these landholders.

#### **Variables for all landholders:**

- Rating of importance for 'improve environment' scale in the topics 'property management goals' (1 if greater than equal to 4; otherwise 0) (IntImpEnvAll);

- Awareness/importance rating for 'environmental health' scale in the topic regional issues (1 if greater than or equal to 3) (IntEnvHealAll);
- Ratings of importance for the item 'Reduced production in the short-term can be justified where there are long-term benefits to natural resources' in the topic 'sustainability' (1 if greater than or equal to 1; otherwise 0) (IntSrtProdAll);
- Ratings of usefulness for various information sources, particularly 'environment groups' (1 if greater than 3.3; otherwise 0) (IntInfEnvGrpsAll);
- Trust in 'environment groups' (1 if greater than 2; otherwise 0) (IntTrstEnvAll); and
- Likelihood of 'setting aside some land under covenant' (1 if greater than 0; otherwise 0) (IntCovAll).

**Variables for landholders with native vegetation:**

- Inverse scores relative to ratings of agreement for the scale 'prefer to clear' (1 if less than -1; 0.5 if -0.99-0, otherwise 0), and 'aesthetics and value' (if -2 then 1, if <-1 then 0.5, otherwise 0) in the topic 'native vegetation management issues'; and
- Ratings of agreement for scale 'timber' (if 0 to one then 0.5; if >1 then 1; else 0) and 'management information confidence' (1 if greater than 1.01; 0.5 if 0.34-1; 0 if < 0.33)

**Variables for landholders with grazing and cropping enterprises:**

- Ratings of agreement with positive statements regarding CRP issues for grazing and cropping.

## Cluster analysis of landholders' interest and engagement in NRM in the Wet Tropics region

After compiling indices to represent 'interest' and 'engagement' in NRM, respondent scores for the indices that applied to all landholders were used to cluster landholders into four and five groups in separate K-Means cluster analyses. After examining the patterns of similarities and differences between the groups in the two solutions, the five group solution was chosen as the solution which most clearly illustrated variations in the population of rural landholders. The average index scores for each of the groups in the five cluster solution are presented in Table 1 and illustrated in Figure 1. The basic characteristics of these groups are described in the following section.

**Table 1:** Average scores for interest and engagement indices by cluster groups.

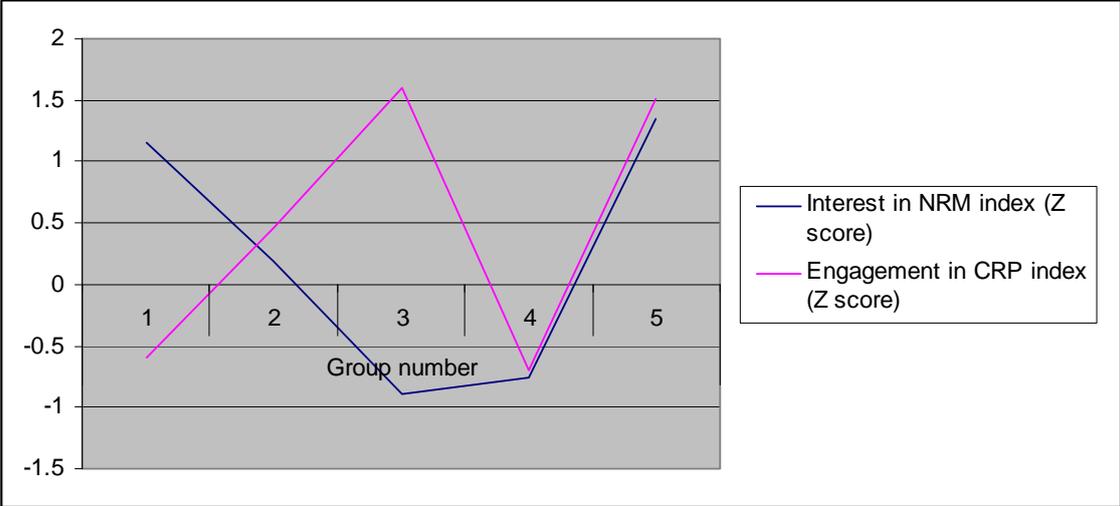
Variable	Cluster groups				
	1	2	3	4	5
Interest in NRM index all respondents (Z score)	1.15	0.19	-0.89	-0.76	1.35
Engagement index all respondents (Z score)	-0.60	0.46	1.60	-0.70	1.51

The prevalence of the groups is as follows:

- Group 1 has a high level of interest in NRM but has low levels of engagement in CRP practices at present. This group forms approximately 20% of the sample.
- Group 2 has a medium level of interest and engagement and makes up a further 20% of the sample.
- Group 3 comprises approximately 10% of the sample, with relatively high levels of engagement but low interest in NRM issues.
- Group 4 has a low level of interest and low engagement in NRM activities, comprising 40% of the sample in this category.
- Group 5 has a high level of interest and engagement in NRM activities and this is the smallest group at 10% of the sample.

**Table 2:** Frequency and relative frequency of membership of cluster groups.

Cluster group	N	Proportion of sample (%)
1	68	21
2	61	19
3	36	11
4	127	40
5	29	9
<b>All respondents</b>	<b>321</b>	<b>100</b>



**Figure 1:** Landholders' level of interest and engagement in NRM by groups clustered on these variables.

## Tests for similarities and differences between landholder groups

The cluster groups differ in terms of the proportions with various primary reasons for landownership (Table 3) and land use types (Table 5). Members of three groups (Groups 2, 3 and 5) are predominantly involved in agriculture. Less than fifty percent of the members of the remaining groups are involved in agriculture as a commercial land use activity. A relatively high proportion of the members of Groups 1 and 2 are in the 'hobby farm' and 'conservation' categories. Each of the groups except Group 3 have members with properties of less than twenty hectares in area, and all have some members with property areas of greater than two hundred hectares (Table 4).

**Table 3:** Proportion of cluster group members with various primary purposes for land ownership.

Cluster group	Primary purpose for landownership (%)				
	Agriculture	Conservation	Hobby/ lifestyle farm	Residential	Other
1	40	15	23	22	
2	72	8	10	8	
3	94	3	3		
4	49	3	18	24	6
5	90	7		3	
<b>All respondents</b>	<b>60</b>	<b>7</b>	<b>14</b>	<b>16</b>	<b>3</b>

Pearson chi square value = 71.120, d.f. = 16, sig. < 0.000. Twelve cells (48%) have an expected count less than 5.

Another means of classifying landholders used in the analyses is according to the type of agriculture they use. Under this classification the hobby/lifestyle farmers and those who listed their primary landownership purpose as 'conservation' were included in a group with the 'other' varied, non-agriculture based land use types. There were differences in the proportion of group members with various dominant land use types in terms of the proportions of members involved in cropping, grazing and residential land uses (Table 4). Half of the landholders in Group 5 are involved in cropping and a further twenty percent in mixed grazing and cropping. Thirty percent of the landholders in Group 3 are involved in grazing; approximately double the proportion in other groups, with nearly fifty percent of this group involved in cropping activities. More than half the landholders in Group 4 are either residential landholders, or are in the 'other' category (which predominantly includes hobby farms and 'other' landholders in this group).

**Table 4:** Proportion of group members that have various land use types.

Cluster group	Land use type (%)				
	Residential only	Grazing	Cropping	Grazing and cropping	Other
1	22	13	22		43
2	7	19	38	14	22
3		31	49	12	8
4	24	18	23	7	28
5	4	18	50	21	7
<b>All respondents</b>	<b>16</b>	<b>18</b>	<b>31</b>	<b>9</b>	<b>26</b>

Pearson chi square value = 62.00, d.f. = 16, sig. < 0.000.

One-way ANOVA tests for differences in the landholding size of the group members indicated significant differences between the groups, although post hoc tests for differences between individual groups were not significant (Table 5).

**Table 5:** Size of landholding (ha) by cluster groups.

Cluster group	N	Mean (ha)	Median (ha)	Std. Error
1	66	56.4	17.5	10.32
2	60	334.4	84.5	198.81
3	36	2,814.6	154.6	2,040.54
4	124	93.6	26.2	19.15
5	27	3,320.7	128.0	2,887.27
<b>All respondents</b>	<b>313</b>	<b>723.3</b>	<b>55.0</b>	<b>345.71</b>

F value 2.93, d.f. = 4, 0.021: Post-hoc tests (Tamhane) n.s.

The average amount of time spent working on the property per week, the proportion of landholders who reported making a profit from on-property enterprises and the average proportion of income from property enterprises reflects the proportions of members who are involved in agriculture. Those in Groups 2, 3 and 5 have the greatest reliance on income from property enterprises, work the most amounts of hours on their farm and are more likely to report making a profit in 2004/2005 (Table 6). Members of Group 3 have the highest values for these variables.

**Table 6:** Average time spent working on property per week and proportion of income from property.

Cluster group	Average hours per week	Made a profit (2004/2005) (%)	Proportion of total income from property (%)
1	24.6	21.5	15.6
2	41.8	53.6	46.8
3	52.8	68.6	63.8
4	26.6	27.4	23.0
5	49.2	53.8	53.2
<b>All respondents</b>	<b>35.1</b>	<b>38.1</b>	<b>32.4</b>

Average hours per week – F value = 14.67, Sig. < 0.000: Post-hoc (Bonferroni): 1, 4 < 2, 3, 5.

Made a profit 2004/2005 – Pearsons chi-square = 35.48, d.f. = 4, p < 0.000.

Proportion of total income from farm – F value = 14.06, Sig. < 0.000: Post-hoc (Tamhane) 1, 4 < 2, 3, 5.

The number of people who live on their property(s) and the number of people supported (who receive income) from the property also reflects the proportions of members that are involved in agriculture. Those respondents who are members of Groups 2, 3 and 5 reported the greatest number of people who live on the property and are supported by the property enterprises (Table 7). The two groups with the highest proportion of members involved in agriculture are the only groups whose landholdings support more people than those who live on the property.

**Table 7:** Mean number of people who live on and are supported by property enterprises by cluster group.

Variable	Cluster group					All respondents
	1	2	3	4	5	
Number of people that live on property	2.6	3.6	3.5	2.4	5.6	3.1
Number of people supported by property	1.1	2.9	4.1	1.7	6.4	2.6

Number of people who live on property – F value = 9.42, Sig. < 0.000: 1, 4 < 5; 2 > 4;

Number of people supported by property – F value = 8.38, Sig. < 0.000: 1 < 2, 3; 3 > 1, 4.

The differences in the time lived on rural properties, in the local district and on the current property, also reflect the proportions of members that are involved in agriculture. Those in Groups 2, 3 and 5 have the highest average values for these variables (Table 8).

**Table 8:** Average time lived on rural properties, in the local district and on the current property, by cluster group.

Variable	Cluster group					All respondents
	1	2	3	4	5	
Time lived on rural properties	23.1	36.1	38.5	26.5	40.9	30.3
Time lived in local district	22.7	36.9	43.9	30.1	43.3	32.8
Time lived on current property	15.0	26.5	32.7	19.4	34.8	22.8

Time lived on rural properties – F value = 7.22, Sig. < 0.000: 1 < 2, 3, 5; 4 < 3, 5.

Time lived in local district – F value = 8.03, Sig. < 0.000: 1 < 2, 3, 5; 4 < 3.

Time lived on current property – F value = 9.89, Sig. < 0.000: 1 < 2, 3, 5; 4 < 3, 5.

A higher proportion of those in the predominantly non-commercial agriculture groups are female when compared to those in the agriculture groups. Of the groups with high proportions of members involved in agriculture, Group 5 has the highest proportion of female members and Group 3 has the lowest (Table 9).

**Table 9:** Proportion of male and female members of cluster groups.

Cluster group	Gender (%)	
	Female	Male
1	32	68
2	10	90
3	9	91
4	34	66
5	18	82
<b>All respondents</b>	<b>25</b>	<b>75</b>

Pearsons chi-square = 18.80, d.f. = 4, p = 0.001.

Chi-square tests (Pearsons' statistic) revealed significant differences in the level of formal education of members of the various cluster groups (Table 10). The greatest differences between the groups include the high proportion of landholders with post-graduate education in Groups 1 and 5, and the high proportion of members with primary education in Group 2.

**Table 10:** Proportion of landholders with various levels of formal education by cluster group.

Cluster group	Education level (%)				
	Primary	Secondary Year 10	Secondary Year 12	Diploma or Degree	Postgraduate Degree
1	3.2	23.8	23.8	31.7	17.5
2	23.2	32.2	16.1	21.4	7.1
3	5.6	33.3	19.4	36.1	5.6
4	10.9	33.7	23.5	26.9	5.0
5	10.7	21.4	17.9	39.3	10.7
<b>All respondents</b>	<b>10.9</b>	<b>30.2</b>	<b>21.2</b>	<b>29.1</b>	<b>8.6</b>

Pearsons chi-square = 27.02, d.f. = 16,  $p = 0.041$ .

Attendance at short courses on land and water management topics, participation in government NRM programs, the preparation of property management or business plans and the use of environmental management systems (EMS) were the four items used to calculate the 'engagement' index for all landholders who participated in the survey. Members of groups that are regarded as 'engaged' in NRM activities (Groups 3 and 5) have high levels of attendance in short courses, involvement in government NRM programs, plan preparation and use of EMS (Tables 11 to 13). The participation rates of these groups contrast dramatically with that of the members of Groups 1 and 4 which have low levels of participation in these activities.

**Table 11:** Proportion of landholders who have attended a short course on property management or have participated in a government NRM program in the last five years by cluster group.

Cluster group	Have attended a short course (%)	Involved in government NRM program last five years (%)
1	8.1	6.1
2	50.9	32.1
3	91.7	47.2
4	10.9	0
5	86.2	59.3
<b>All respondents</b>	<b>34.7</b>	<b>17.9</b>

If attended short course – Pearsons chi-square = 141.28, d.f. = 4,  $p < 0.000$ .

Involved in Government NRM program last five years – Pearsons chi-square = 92.27, d.f. = 4,  $p < 0.000$ .

**Table 12:** Proportion of landholders with an existing property management or business plan, or else one in preparation, by cluster group.

Cluster group	Have you prepared a written property plan or a business plan? (%)		
	No	In progress	Yes
1	82.4	11.8	5.8
2	42.9	10.7	46.4
3	8.8	17.7	73.5
4	90.8	4.2	5.0
5	18.5	14.8	66.7
<b>All respondents</b>	<b>64.6</b>	<b>9.5</b>	<b>25.9</b>

Pearsons chi-square = 139.65, d.f. = 8,  $p < 0.000$ .

**Table 13:** Proportion of landholders who use a farm or environmental management system by cluster group.

Cluster group	Do you use a recognised farm or environmental management system? (%)	
	No	Yes
1	96.9	3.1
2	85.2	14.8
3	47.2	52.8
4	98.4	1.6
5	55.2	44.8
<b>All respondents</b>	<b>85.7</b>	<b>14.3</b>

Pearsons chi-square = 88.80, d.f. = 4,  $p < 0.000$ .

The pattern of engagement in NRM activities by groups defined on the basis of their interest and engagement in NRM described in the previous paragraphs was replicated in the case of the proportion of group members who had undertaken pest and weed control (Table 14). Again, the members of Group 4 displayed the lowest levels of activity, particularly in terms of pest control.

**Table 14:** Proportion of landholders who have carried out pest or weed control by cluster group.

Cluster group	Have carried out pest control (%)	Have carried out weed control (%)
1	55.8	92.7
2	59.6	93.6
3	87.9	100.0
4	39.1	81.7
5	61.5	92.9
<b>All respondents</b>	<b>55.2</b>	<b>89.9</b>

Pest control – Pearsons chi-square = 24.65, d.f. = 4,  $p < 0.000$ .

Weed control – Pearsons chi-square = 12.28, d.f. = 4,  $p = 0.015$ .

One of the items used to calculate the ‘interest in NRM’ index for all survey respondents was the rating of importance given to the scale ‘environmental health’ in the topic ‘property NRM issues’. On this issue the two groups defined as having a high interest in NRM issues (Groups 1 and 5) had higher average ratings of importance than the members of Group 4, who gave the lowest average ratings of importance for all property NRM issues (Table 15, Figure 2).

**Table 15:** Average ratings of importance for various scales of property NRM issues by cluster group\*.

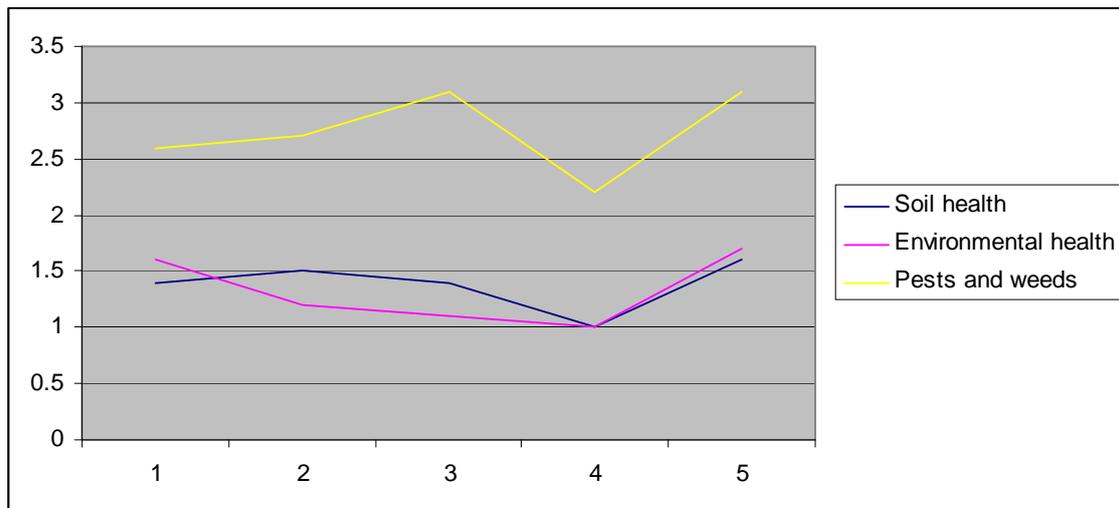
Property NRM issue scale	Cluster group					
	1	2	3	4	5	All respondents
Soil health	1.4	1.5	1.4	1.0	1.6	1.3
Environmental health	1.6	1.2	1.1	1.0	1.7	1.2
Pests and weeds	2.6	2.7	3.1	2.2	3.1	2.6

Soil health – F value = 3.43, d.f. = 4, p = 0.010: 2 > 4.

Environmental health – F value = 7.79, d.f. = 4, p < 0.000: 1 > 2, 4; 5 > 4.

Pests and weeds – F value = 5.20, d.f. = 4, p < 0.000: 3, 5 > 4.

\*Scale ranged from 1 = *Not Important* to 5 = *Very Important*.



**Figure 2:** Average ratings of importance for scales representing various property NRM issues by cluster groups. Scale ranged from 1 = *Not Important* to 5 = *Very Important*.

The scale ‘lack of environmental health’ was another item used to calculate the ‘interest in NRM’ index with the highest average scores again recorded for the members of Groups 1 and 5 (Table 16, Figure 3). There were also significant differences between the groups in terms of their scores for the other scales within this topic, with the above groups consistently rating these scales as more important than a number of the other groups.

**Table 16:** Average ranking of importance for various scales for regional development issues by cluster group\*.

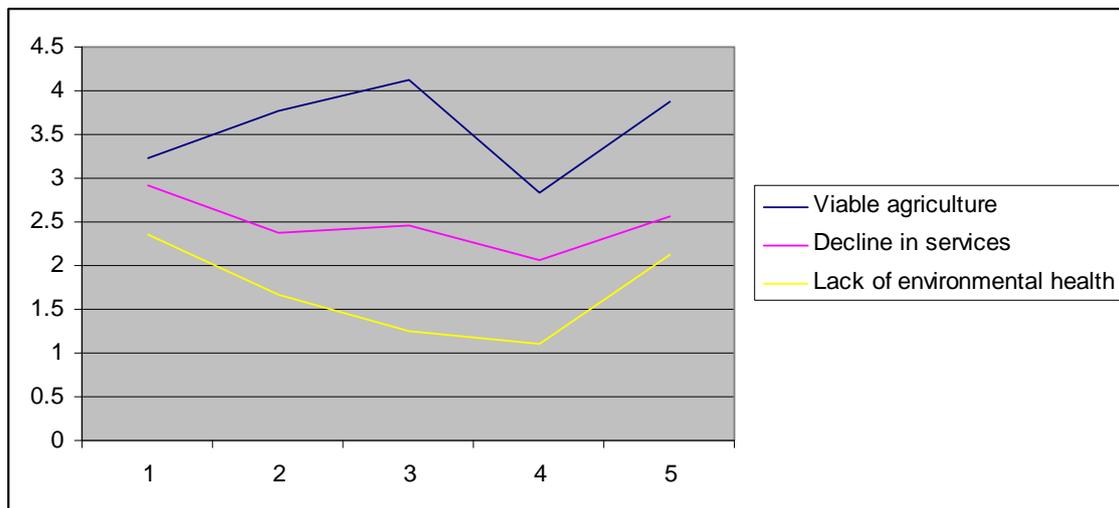
Cluster group	Viable agriculture	Decline in services	Lack of environmental health
1	3.22	2.92	2.35
2	3.78	2.38	1.66
3	4.13	2.46	1.25
4	2.84	2.07	1.11
5	3.87	2.57	2.12
<b>All respondents</b>	<b>3.39</b>	<b>2.42</b>	<b>1.62</b>

Viability of agriculture – F value = 9.35, d.f. = 4, p < 0.000; Post hoc (Tamhane) 3 > 1, 4; 5, 2, 3 > 4.

Decline in services – F value = 4.81, d.f. = 4, p = 0.001; Post hoc (Bonferroni) 1 > 4.

Lack of environmental health – F value = 14.99, d.f. = 4, p < 0.000; Post-hoc (Tamhane) 2, 3, 4 < 1; 3 < 5; 4 < 1, 2, 5.

\*Scale ranged from 1 = *Not Important* to 5 = *Very Important*.



**Figure 3:** Average ratings of importance for scales representing various regional development issues by cluster groups. Scale ranged from 1 = *Not Important* to 5 = *Very Important*.

A more complex pattern of differences between the groups was revealed by testing the groups' ratings of importance for scales within the topic 'property management goals' (Table 17, Figure 4). The members of Groups 1, 2 and 5 indicated higher ratings of importance for the scale 'improve environment' than the other two groups, and higher ratings of importance for the scale 'keep in family' than the members of Group 4. The goal of 'building business' was most important to the members of Group 3. This group and the members of Groups 2 and 5 were all more motivated by this goal than the members of Group 4.

**Table 17:** Average rating of importance for various scales for property management goals by cluster group\*.

Property management goal scale	Cluster group					
	1	2	3	4	5	All respondents
To build business	3.4	4.1	4.4	3.0	4.1	3.5
To improve the environment	4.6	4.2	3.7	3.4	4.5	3.9
To keep in the family	4.2	4.0	3.8	3.6	4.1	3.9

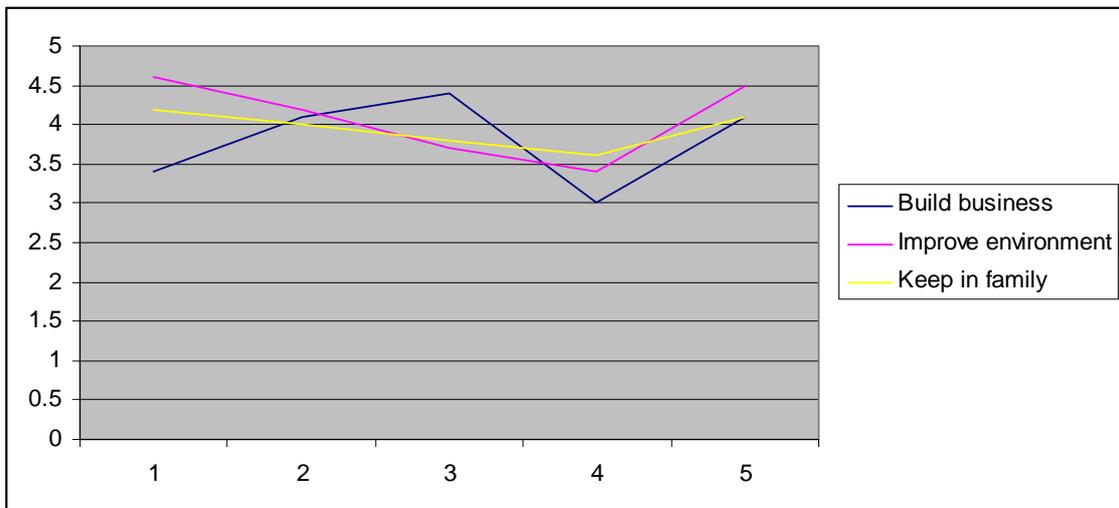
To build business – F value = 11.12, d.f. = 4, p < 0.000; Post hoc (Tahmane) 1 < 3; 2, 3, 5 > 4.

To improve the environment – F value = 23.26, d.f. = 4, p < 0.000; Post hoc (Tahmane) 1, 2, 5 > 3, 4; 1 > 2.

To keep in the family – F value = 4.14, d.f. = 4, p < 0.000; Post hoc (Tahmane) 1 > 4.

\*Scale ranged from 1 = *Not Important* to 5 = *Very Important*.

Significant differences were identified between groups on two of the four scales constructed for the topic ‘property management intentions’ (Table 18, Figure 5). Subsequent post-hoc (Bonferroni) tests for differences between individual groups were not significant for ratings of ‘likelihood’ on the scale ‘sell property’, but indicated that the landholders in Group 5 were more likely to intend to expand their business than the members of Group 4.



**Figure 4:** Average ratings of importance for scales representing various property management goals by cluster groups. Scale ranged from 1 = *Not Important* to 5 = *Very Important*.

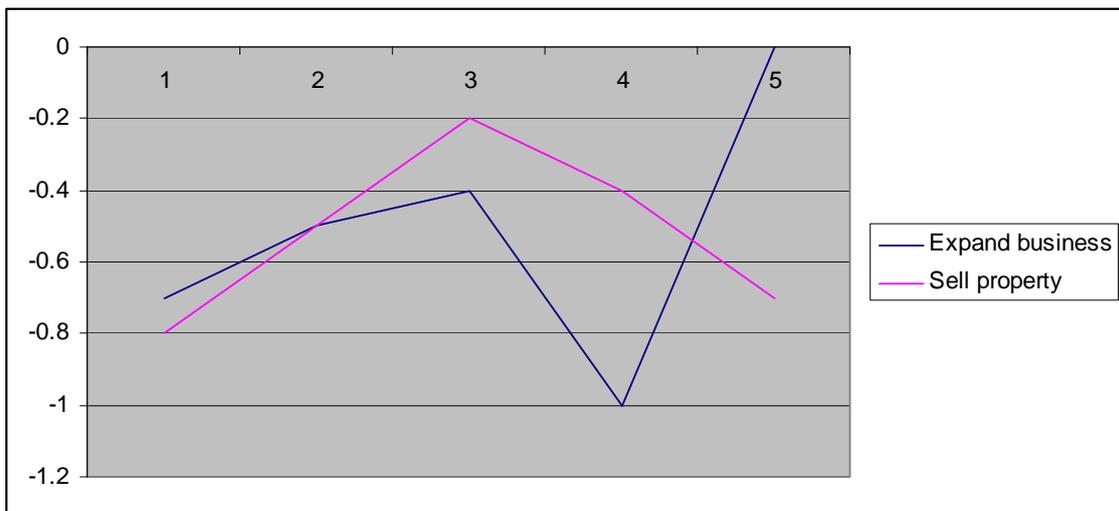
**Table 18:** Average rating of importance for various scales of property management intentions by cluster group\*.

Property management intention scale	Cluster group					
	1	2	3	4	5	All respondents
To expand business	-0.7	-0.5	-0.4	-1.0	0.0	-0.6
To sell property	-0.8	-0.5	-0.2	-0.4	-0.7	-0.5

To expand business – F value = 5.16, d.f. = 4, p < 0.000 (Bonferroni): 5 > 4.

To sell property – F value = 2.46, d.f. = 4, p = 0.046: Post hoc (Bonferroni) n.s.

\*Scale ranged from -2 = *Strongly Disagree* to 2 = *Strongly Agree*.



**Figure 5:** Average ratings of importance for scales representing various property management intentions by cluster groups. Scale ranged from -2 = *Strongly Disagree* to 2 = *Strongly Agree*.

**Differences between groups relating to the perceived usefulness of various information sources to assist property management**

There are a series of significant differences between the groups in terms of their ratings of the usefulness of various information sources to assist property management decisions (Table 19, Figure 6). The members of Group 5 have the highest average scores for all the scales relating to the usefulness of various information sources while the members of Group 4 are consistently lowest across all information sources. The members of Groups 1 and 2 also have relatively high ratings of usefulness for most of the information sources. The two groups who have the highest proportion of non-agricultural landholders (Groups 1 and 4) have, unsurprisingly, the lowest scores for the scales ‘enterprise information’ and ‘finance and family’. Scores for the scale ‘environment groups’ display the largest variations between groups; differentiating the members of Groups 1 and 5 from the others.

**Table 19:** Average ratings of usefulness for scales of various information sources\*.

Information source scale	Cluster group					
	1	2	3	4	5	All respondents
Enterprise information	1.8	2.5	3.0	1.4	3.0	2.0
Finance and family	3.0	3.4	3.6	2.4	3.6	3.0
Environment groups	3.0	2.4	2.0	1.1	3.7	2.1
Media sources	3.3	3.2	3.0	2.4	3.4	2.9
Sum of averages per Cluster group	11.1	11.5	11.6	7.3	13.7	10

Enterprise information – F value = 18.80, d.f. = 4, p < 0.000: 1 < 3, 5; 2 > 4; 3 > 1, 4; 2, 3, 5 > 4.

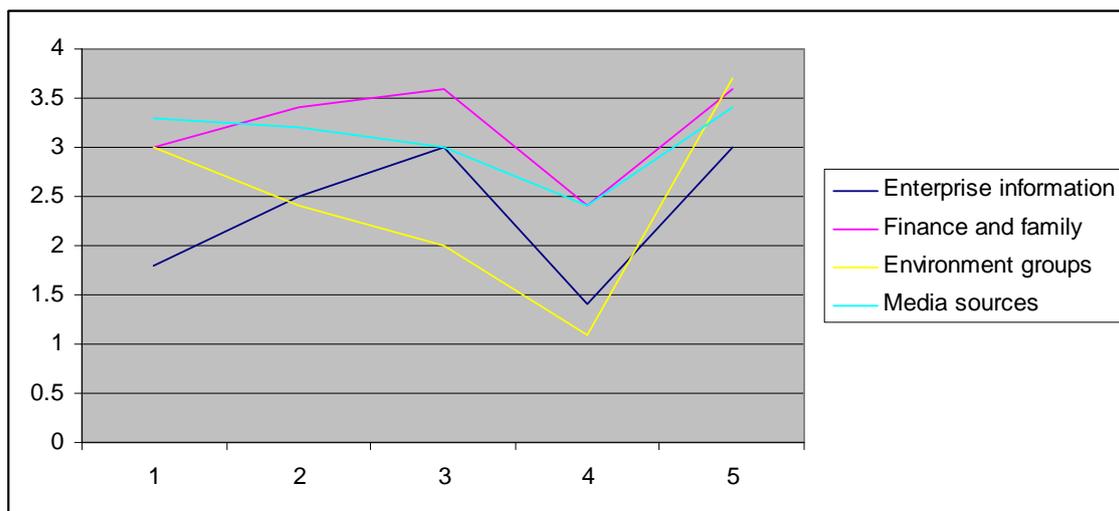
Finance and family – F value = 10.54, d.f. = 4, p < 0.000: 2, 3, 5 > 4.

Environment groups – F value = 45.53, d.f. = 4, p < 0.000: 1 > 3, 4; 4 < 2, 3, 4, 5; 5 > 1, 2, 3, 4.

Media sources – F value = 9.17, d.f. = 4, p < 0.000: 4 < 1, 2, 3, 5.

All post-hoc tests Tukey.

\*Scale ranged from 1 = *Not Important* to 5 = *Very Important*.



**Figure 6:** Average ratings of usefulness for scales of various information sources. Scale ranged from 1 = *Not Important* to 5 = *Very Important*.

### *Differences between groups regarding trust in institutions and people*

Compared to the ratings for various information sources, statistical testing revealed fewer differences between the cluster groups in terms of their ratings of trust in various institutions and people (Table 20, Figure 7). Differences between groups were revealed in the scores for the scales 'productivity groups', 'state government' and 'environment groups'. Members of Group 5 had the highest levels of trust in all institutions and groups, with the exception of 'environment groups', where they were second highest. The two groups with the highest proportion of agricultural operators (Groups 3 and 5) predictably had the highest trust in 'productivity groups', while highest trust levels for the 'state government' was shared by Groups 1 and 5.

**Table 20:** Average ratings for scales relating to trust in institutions and people\*.

Institution / group	Cluster group					
	1	2	3	4	5	All respondents
Productivity groups	1.6	1.8	2.0	1.4	2.1	1.7
Government, general	1.7	1.6	1.5	1.5	1.7	1.6
State government	1.9	1.7	1.4	1.6	1.9	1.7
Neighbours	2.3	2.4	2.2	2.3	2.4	2.3
Environment groups	2.3	1.9	1.5	1.5	2.2	1.8

Productivity groups – F value: d.f. =, p 0.007: Post-hoc (Tahmane) 3, 5 > 4.

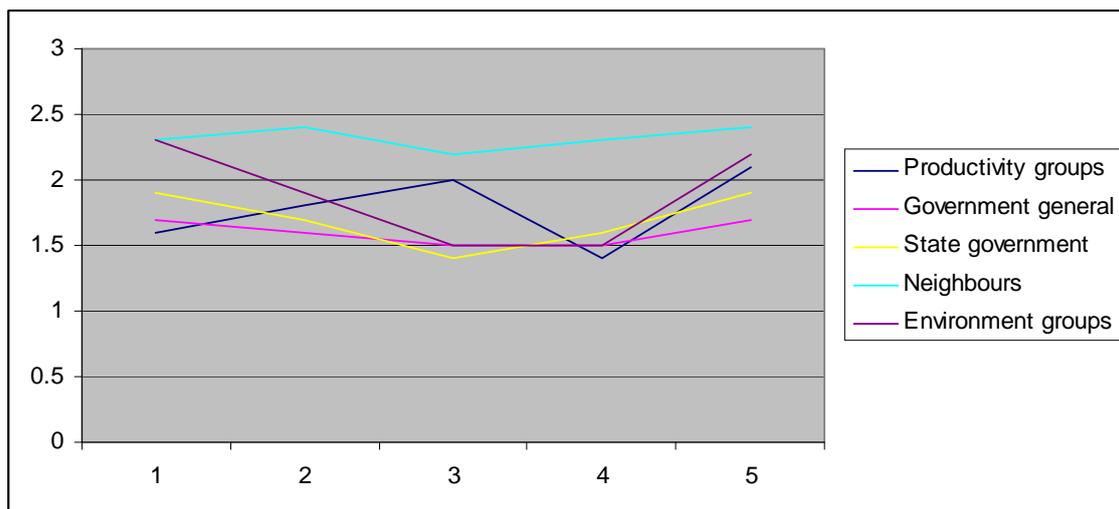
Government general – F value: n.s

State government – F value: d.f. = 4, p < 0.000: (Bonferroni) 1, 5 > 3; 1 > 4.

Neighbours – F value: n.s.

Environment groups – F value: d.f. = 4, p < 0.000: (Tahmane) 1, 5 > 2, 3, 4; 2 > 3, 4.

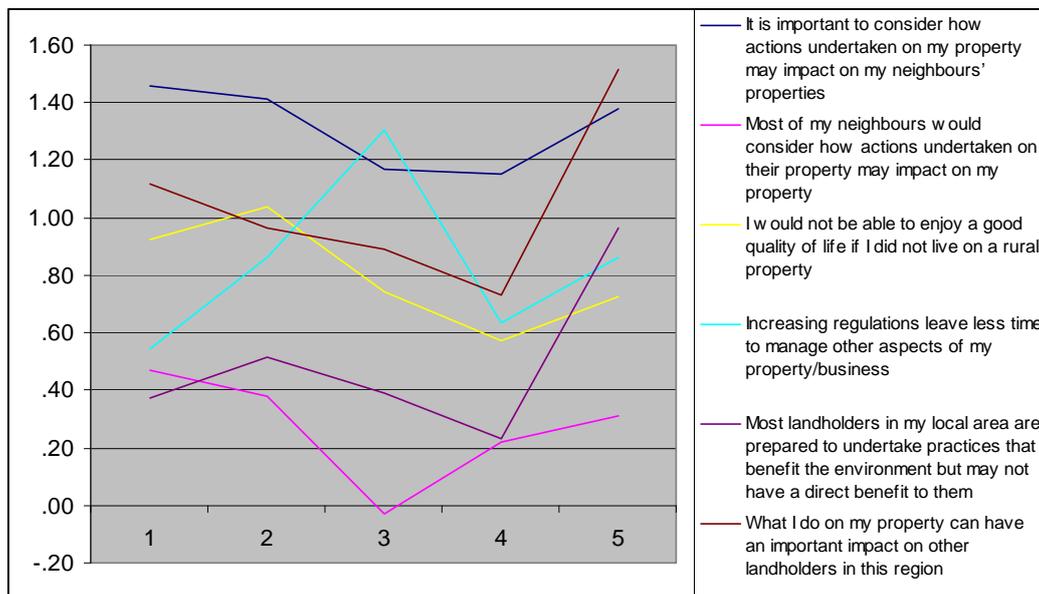
\* Scale ranged from 1 = *Low level of trust* to 3 = *High level of trust*.



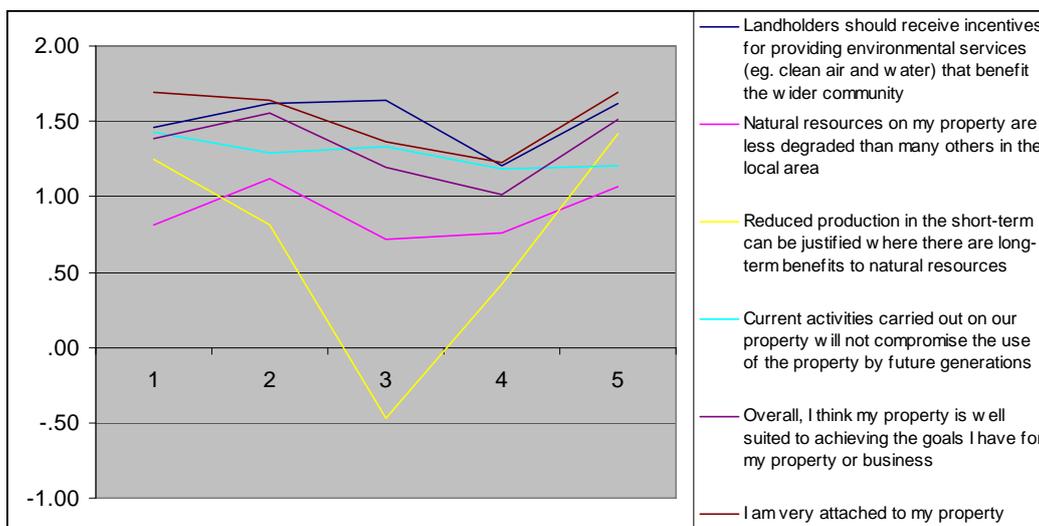
**Figure 7:** Average ratings for scales relating to trust in institutions and people. Scale ranged from 1 = *Low level of trust* to 3 = *High level of trust*.

### Differences between groups relating to perception of sustainability issues

The perception of issues related to ‘sustainability’ differ between the groups (Figures 8 and 9, Table 21). Members of Group 3 are the most concerned about the impacts of increasing regulations, and generally disagreed with the statement ‘reduced production in the short term can be justified when there are long-term benefits to natural resources’. The members of Group 5 were most supportive of statements that ‘landholders’ own actions have important impacts on others’. Two of the groups dominated by ‘agriculturalists’, Groups 2 and 3 were more supportive than members of Group 4 that landholders should receive payment for providing environmental services. Members of Group 4 revealed the least agreement that other landholders would undertake practices to benefit the environment with no benefit to themselves. The members of this group also appeared least satisfied with their properties, with the lowest support for the statements ‘I am very attached to my property’ and ‘Overall, the property is well suited to my goals for property or business management’.



**Figure 8:** Mean scores of agreement for statements relating to sustainability issues.



**Figure 9:** Mean scores of agreement for statements relating to sustainability issues.

**Table 21:** Results of tests for differences between groups' agreement with statements concerning issues related to 'sustainability'.

Statement	F value	Sig.	Post-hoc tests*
'It is important to consider how actions undertaken on my property may impact on my neighbours' properties.'	2.65	<b>0.033</b>	n.s.
'Most of my neighbours would consider how actions undertaken on their property may impact on my property.'	1.31	0.265	
'I would not be able to enjoy a good quality of life if I did not live on a rural property.'	1.83	0.122	
'Increasing regulations leave less time to manage other aspects of my property/business.'	3.91	<b>0.004</b>	3 > 1, 4
'Most landholders in my local area are prepared to undertake practices that benefit the environment but may not have a direct benefit to them.'	3.54	<b>0.008</b>	Tamhane: 5 > 4 (p = 0.003)
'What I do on my property can have an important impact on other landholders in this region.'	2.86	<b>0.024</b>	5 > 4 (p = 0.021)
'I am very attached to my property.'	6.72	<b>0.000</b>	Tamhane: 4 < 1, 2, 5 (p < 0.008)
'Landholders should receive incentives for providing environmental services that benefit the wider community.'	4.29	<b>0.002</b>	2, 3 > 4 (p < 0.042)
'Natural resources on my property are less degraded than many others in the local area.'	2.26	0.063	
'Reduced production in the short-term can be justified where there are long-term benefits to natural resources.'	30.60	<b>0.000</b>	1, 5 > 2, 3, 4 (p < 0.049); 4 < 1, 5 (p < 0.000); 3 < 1, 2, 4, 5 (p < 0.000)
'Current activities carried out on our property will not compromise the use of the property by future generations.'	0.98	0.417	
'Overall, I think my property is well suited to achieving the goals I have for my property or business.'	7.27	<b>0.000</b>	4 < 1, 2, 5 (p < 0.010)

\* Post-hoc tests Bonferroni unless indicated.

### *Differences between groups relating to participation in social groups*

The rates and intensity of participation in social groups differ between the groups in several but not all social group types (Tables 22 to 25). In general, members of Group 5 reported the greatest level of involvement in social groups, with Group 4 having the least involvement. Group 5 members were clearly more involved in Landcare and catchment NRM groups than members of the other group. Members of Group 3 reported significantly higher levels of participation in 'industry groups' than the groups with fewer members involved in agricultural production (i.e. Groups 1, 2 and 4).

**Table 22:** Results of tests for differences in participation rates between cluster groups.

Statement	F value	Sig.	Post-hoc tests
Sporting groups/clubs	0.39	0.813	
Civic groups (e.g. Rotary, Lions)	1.87	0.115	
Emergency services (e.g. Bush Fire Brigade, State Emergency Service)	3.82	0.005	Post-hoc tests n.s.
School committees (e.g. P&C)	0.81	0.518	
Neighbourhood / Rural Watch	2.86	0.024	Post-hoc tests n.s.
Local Landcare group	20.15	0.000	4 < 1, 2, 5 (p < 0.031); 5 > 1, 2, 3, 4 (p < 0.005)
Catchment / Sub-regional NRM group	18.20	0.000	5 > 1, 2, 3, 4 (p < 0.013)
Industry group	21.61	0.000	1 < 2, 3, 5 (p < 0.004); 3 > 1, 2, 4 (p < 0.038); 4 < 2, 3, 5 (p < 0.038)
Political/lobby group	9.36	0.000	5 > 4 (p = 0.006)
Special interest group	4.40	0.002	1 > 4 (p = 0.007)
Recreation group	0.76	0.553	
Church group	2.19	0.070	
Country Women's Association	0.50	0.739	

**Table 23:** Rates of participation in local Landcare groups by cluster group.

Cluster group	Local Landcare group (%)				
	None	Once per year or less	A few times per year	Every month or two	Weekly
1	69.4	12.9	11.3	4.8	1.6
2	67.9	19.6	7.1	5.4	
3	73.5	17.7	5.9	2.9	
4	91.5	5.2	2.5	0.8	
5	25.9	14.8	40.7	7.5	11.1
<b>All respondents</b>	<b>74.4</b>	<b>11.8</b>	<b>9.1</b>	<b>3.4</b>	<b>1.3</b>

**Table 24:** Rates of participation in catchment NRM groups by cluster group.

Cluster group	Catchment / Sub-regional NRM group (%)				
	None	Once per year or less	A few times per year	Every month or two	Weekly
1	83.9	8.1	6.5	1.5	
2	89.1	5.5		1.8	3.6
3	75.8	18.2	3.0	3.0	
4	95.8	0.8	3.4		
5	36.0	20.0	24.0	8.0	12.0
<b>All respondents</b>	<b>84.6</b>	<b>6.8</b>	<b>5.2</b>	<b>1.7</b>	<b>1.7</b>

**Table 25:** Rates of participation in industry groups by cluster group.

Cluster group	Industry group (%)				
	None	Once per year or less	A few times per year	Every month or two	Weekly
1	79.0	4.8	11.4	4.8	
2	48.3	8.9	21.4	19.6	1.8
3	17.6	5.9	32.4	29.4	14.7
4	72.9	4.2	15.3	5.9	1.7
5	32.0		20.0	36.0	12.0
<b>All respondents</b>	<b>59.7</b>	<b>5.1</b>	<b>18.0</b>	<b>13.6</b>	<b>3.6</b>

### *Differences between groups relating to native vegetation management*

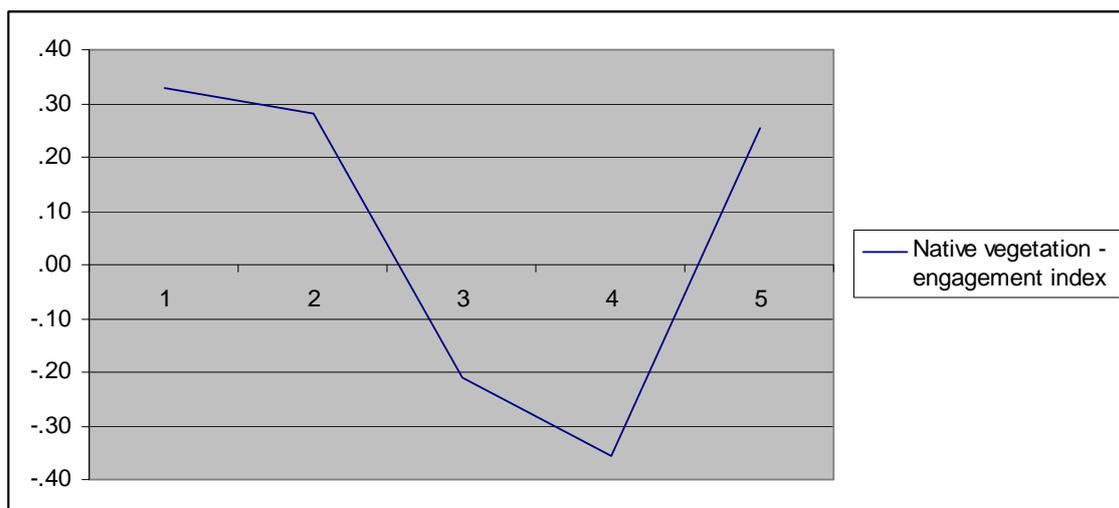
There is significant variation in the proportion of landholdings under native vegetation between the cluster groups (Table 26). The groups with the lowest proportions of land under native vegetation are those with the highest proportions of ‘agricultural’ landholders (i.e. Groups 2, 3 and 5).

**Table 26:** Average proportions of landholdings under native vegetation by cluster group.

Cluster groups	N	Proportion of property under native vegetation (%)	Proportion of property under native vegetation RSE
1	38	54	5.60
2	28	36	6.25
3	17	15	5.57
4	71	54	3.67
5	16	24	6.57
<b>All respondents</b>	<b>170</b>	<b>44</b>	<b>2.58</b>

F value = 8.32, d.f. = 4, p < 0.000: 1, 4 > 3, 5.

The relative scores of the index to measure engagement in vegetation management of the group members with areas of native vegetation differs to that of the engagement index for all respondents (Figure 10). While Group 1 members had low scores on the index for CRP engagement applicable to all respondents, they had the highest score for engagement in vegetation management activities. On the other hand, Group 3 revealed relatively high levels of engagement and low levels of interest in NRM issues in these indices for all respondents, but scored relatively low on the index of engagement for vegetation management.



**Figure 10:** Average scores of engagement in native vegetation management activities by cluster group. One-way ANOVA – F value: 5.15; p = 0.001; Bonferroni: 4 < 1, 2.

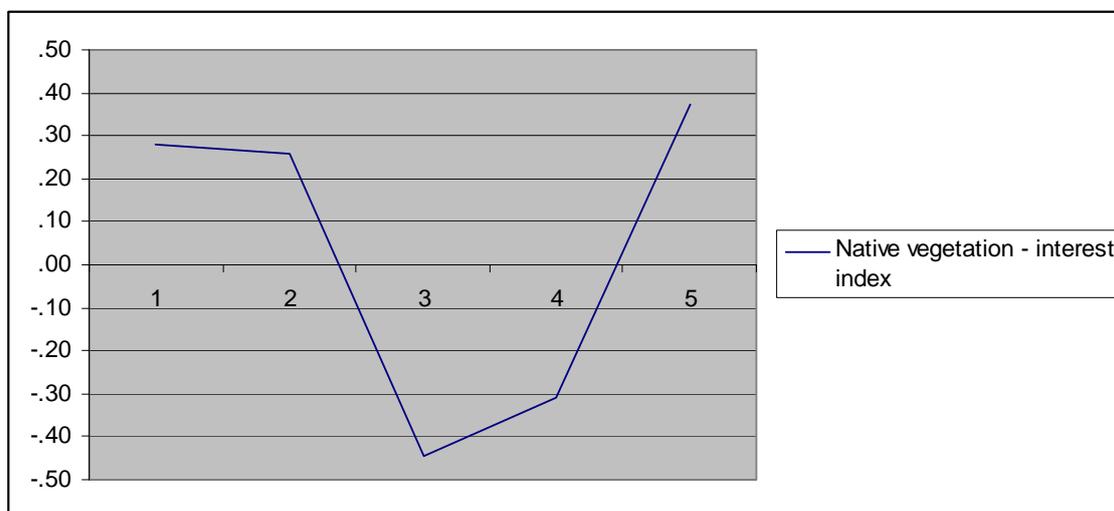
Significant differences were identified in the scores for the vegetation management interest index of the cluster groups (Table 27, Figure 11). Unlike the vegetation management engagement index scores, the scores of these groups are generally consistent with those for the 'interest in NRM index' which was used as a criterion for defining the groups. While the members of Groups 2, 3 and 5 have relative high and the group four members relatively low scores for this index as would be anticipated, the difference is that members of Group 3 in this case have low engagement and low interest scores.

**Table 27:** Landholders' interest in native vegetation management\*.

Cluster groups	N	Mean	Std deviation
1	49	1.85	0.730
2	38	1.83	1.009
3	21	1.19	1.078
4	72	1.31	0.811
5	22	1.93	0.863
<b>All respondents</b>	202	1.59	0.908

F value = 5.58, d.f. = 4,  $p < 0.000$ : 1, 2, 5 > 4; 1 > 3.

\* Index scores range from 0 = *Not interested in vegetation management* to 4 = *Highly interested in vegetation management*.



**Figure 11:** Average scores for the index of 'interest in native vegetation management' by cluster group.

Differences between the groups in terms of the participation of members in vegetation management activities are broadly consistent with the group scores for the vegetation engagement index as participation in these activities were used to compute the index (Table 28). The low levels of engagement of the members of Groups 3 and 4 are evident across the three activities listed in Table 28.

**Table 28:** Landholders’ participation in vegetation management activities by cluster group.

Cluster groups	Encourage regrowth of native vegetation (%)	Have a map of the remnant vegetation types on property (%)	Use native forest area to gather non-timber forest products (%)
1	75.0	17.6	29.2
2	63.8	40.0	14.6
3	52.8	23.8	0
4	43.3	13.0	12.5
5	79.3	52.2	21.7
<b>All respondents</b>	58.5	24.5	16.4

Encourage regrowth of native vegetation – Pearsons chi-square = 25.33, d.f. = 4, p < 0.000.

Have a map of the remnant vegetation types on property – Pearsons chi-square = 21.52, d.f. = 4, p < 0.000.

Use native forest area to gather non-timber forest products – Pearsons chi square = 11.27, d.f. = 4, p = 0.024.

Other differences were identified between groups for the activities ‘use forest areas for recreation’ and ‘maintain walking tracks’ that were significant at the 10% confidence level (p < 0.10) but not at the 5% level.

Scores for the ‘interest in native vegetation index’ were calculated based on respondents’ ratings of agreement with four of the five scales in the topic ‘vegetation management issues’ (excluding ‘management resource difficulties’). While the members of Group 3 have only an average of 15% of their properties covered by native vegetation, they still had the highest average level of agreement with the ‘prefer to clear forest’ and ‘aesthetics and value decreased’ scales, contrasting with the members of Group 1 who have a relatively high proportion of land under native vegetation and the highest level of disagreement with these scales (Table 29, Figure 12).

**Table 29:** Average ratings for various scales relating to vegetation management issues\*.

Vegetation management issue	Cluster group					
	1	2	3	4	5	All respondents
Prefer to clear forest	-0.9	-0.3	0.2	-0.2	-0.4	-0.4
Management resource difficulties	0.5	0.4	0.6	0.4	0.6	0.5
Management information available	0.1	0.5	0.3	0.1	0.6	0.3
Timber production possible	-0.3	0.2	0.0	0.4	0.1	-0.2
Aesthetics and value decreased	-1.3	-1.1	-0.3	-0.8	-1.2	-1.0

Prefer to clear forest – F value = 7.13, d.f. = 4, p < 0.000: 1 < 2, 3, 4.

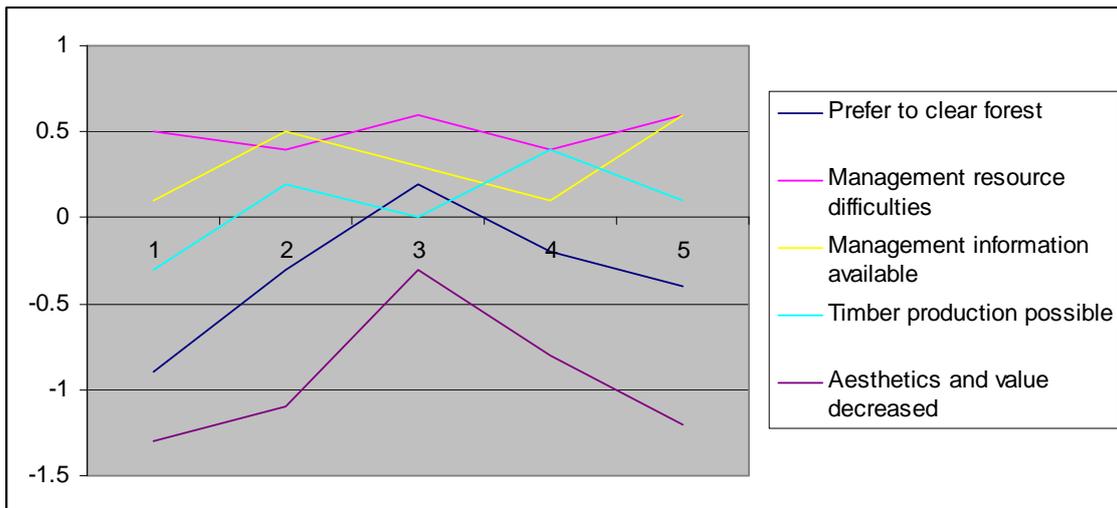
Management resource difficulties – F value = n.s.

Management information available – F value = 3.54, p = 0.008: post hoc tests n.s.

Timber – F value = 2.72, d.f. = 4, p = 0.031: post-hoc tests n.s.

Aesthetics and value decreased – F value = 6.19, p < 0.000: 1 < 3, 4; 3 > 1, 2, 5.

\* Scale of -2 = *Strongly Disagree* to 2 = *Strongly Agree*. Note: Post-hoc tests all Bonferroni.



**Figure 12:** Average ratings of agreement for various scales relating to vegetation management issues.

### *Grazing management practices*

There were no significant differences between the groups in terms of the overall index of engagement in grazing management practices. Significant differences were detected between groups in terms of their adoption of controlled grazing and the use of soil testing to determine fertiliser requirements (Tables 30 and 31). Some caution is required in interpreting the results presented in Table 30 as more than fifty percent of cells used in the analysis table had an expected frequency of less than five.

**Table 30:** Landholders' adoption of controlled grazing practices by cluster group.

Cluster group	Use controlled grazing to maintain surface cover in stocked paddocks (%)			
	None	Some paddocks	Most paddocks	All paddocks
1	14.8	3.7	14.8	66.7
2	8.7	21.7	13.1	56.5
3	12.5	18.8	43.7	25.0
4	25.5	14.9	12.8	46.8
5	30.8		7.7	61.5
<b>All respondents</b>	<b>19.0</b>	<b>12.7</b>	<b>16.7</b>	<b>51.6</b>

Pearsons chi-square = 21.66, d.f. = 12, p = 0.042.

Note: 55% of cells have expected count of <5.

**Table 31:** Landholders' adoption of soil testing by cluster group.

Cluster group	Use soil testing to determine fertiliser requirements (%)			
	None	Some paddocks	Most paddocks	All paddocks
1	59.3	7.4	3.7	29.6
2	18.2	40.9	18.2	22.7
3	31.2	18.7	43.8	6.3
4	53.3	22.2	2.3	22.2
5	8.3	25.0	25.0	41.7
<b>All respondents</b>	<b>41.0</b>	<b>22.1</b>	<b>13.1</b>	<b>23.8</b>

Pearsons chi-square = 39.63, d.f. = 12, p < 0.000.

Testing for differences in attitudes to grazing management issues revealed differences in two of the six statements assessed by respondents in the survey (Table 32, Figure 13). The groups' responses are again largely consistent with the relative scores on the index of 'interest in NRM issues' used in the cluster analysis to define the groups. Members of Groups 1 and 5 have the highest levels of disagreement with negative statements about the efficacy of fencing to protect sensitive areas and highest levels of agreement with positive statements about the effects of controlled grazing practices with the opposite true for the members of Groups 3 and 4.

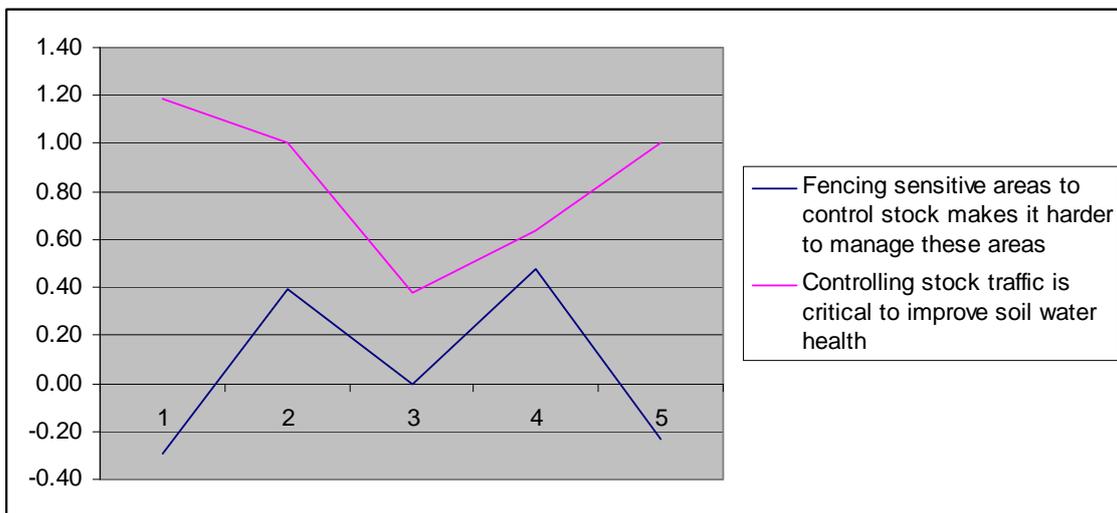
**Table 32:** Average ratings of agreement with issues related to grazing practices by cluster group\*.

Cluster group	'Fencing sensitive areas to control stock makes it harder to manage these areas'	'Controlling stock traffic is critical to improve soil water health'
1	-0.30	1.19
2	0.39	1.00
3	0.00	0.38
4	0.48	0.64
5	-0.23	1.00
<b>All respondents</b>	<b>0.16</b>	<b>0.83</b>

'Fencing sensitive areas ...' – F value = 3.48, d.f. = 4, p = 0.044: Post-hoc tests (Bonferroni) n.s.

'Controlling stock traffic ...' – F value = 2.35, d.f. = 4, p = 0.014: Post hoc tests (Bonferroni) 1 > 3.

\* Ratings range from -2 = *Strongly Disagree* to 2 = *Strongly Agree*.



**Figure 13:** Average ratings of agreement for issues related to grazing practices by cluster group. Scores range from -2 = *Strongly Disagree* to 2 = *Strongly Agree*.

### *Crop management practices*

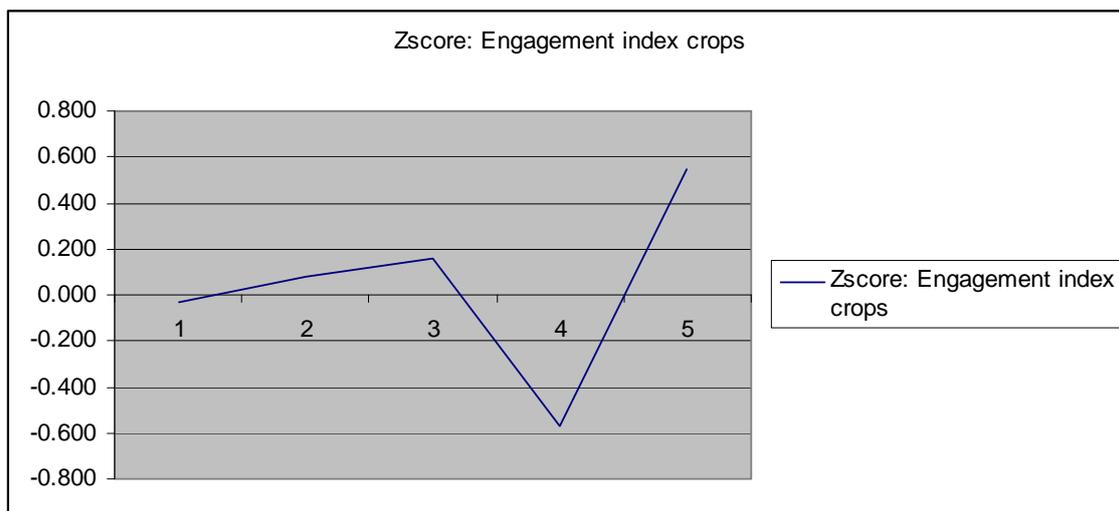
There were significant differences between the cluster groups in terms of the proportion of each group that has some cropping land (Table 33). The groups with the highest proportions of agricultural operators have the highest proportion of members with cropping land, led by Group 3.

**Table 33:** Whether landholders have any cropping land by cluster group.

Cluster groups	Whether landholders have cropping land (%)	
	No	Yes
1	71.9	28.1
2	42.9	57.1
3	25.7	74.3
4	74.3	25.7
5	34.5	65.5
<b>All respondents</b>	<b>58.2</b>	<b>41.8</b>

Pearsons chi-square = 44.34, d.f. = 4, p < 0.000.

Groups differed in their average scores on the ‘index of engagement’ in cropping activities in a manner consistent with the index of engagement for all respondents for all respondents used to define the groups (Figure 14).



**Figure 14:** Average (standardised) score on the index of engagement in recommended cropping practices by cluster group.

In terms of the interest in NRM issues, cluster groups differed significantly in terms of only one of the six statements regarding issues related to the use of CRPs appraised by respondents with cropping land. While all of the groups' members agreed with the statement 'reduced tillage improves soil health and reduces erosion', the level of agreement was significantly higher among the Group 2 relative to Group 4 (Table 34).

**Table 34:** Average ratings of agreement with the statement 'reduced tillage improves soil health and reduces erosion' by survey respondents who have cropping land by cluster group\*.

Cluster group	'Reduced tillage improves soil health and reduces erosion'
1	1.27
2	1.44
3	0.93
4	0.87
5	1.48
<b>All respondents with cropping land</b>	<b>1.17</b>

F values = 4.02, d.f. = 4, p = 0.004: 2 > 4.

\* Scale ranged from -2 = *Strongly Disagree* to 2 = *Strongly Agree*.

The cluster groups differed in terms of their adoption of a number of CRPs (Tables 35 to 38). Members of Groups 3 and 5 exhibit the lowest proportions of members who have not adopted these practices at all, while Group 1 consistently has the lowest levels of partial adoption of these practices. The members of Group 4 have the lowest level of adoption of all the practices described in Tables 35 to 38 with the exception of the adoption of legume rotations, where they have the second lowest level of non-adoption.

**Table 35:** Whether landholders have adopted minimum tillage by cluster group.

Cluster group	Currently use minimum tillage (%)		
	No	Partly	Yes
1	30.8	11.5	57.7
2	20.0	40.0	40.0
3	3.7	14.8	81.5
4	35.9	20.5	43.6
5	10.0	35.0	55.0
<b>All respondents</b>	<b>21.8</b>	<b>24.5</b>	<b>53.7</b>

Pearsons chi-square = 23.04, d.f. = 8, p = 0.030.

**Table 36:** Whether landholders have adopted soil testing for fertilizer use by cluster group.

Cluster group	Currently use soil testing (%)		
	No	Partly	Yes
1	29.6	3.7	66.7
2	19.4	16.7	63.9
3	6.9	37.9	55.2
4	44.2	20.9	34.9
5	4.8	23.8	71.4
<b>All respondents</b>	23.7	20.5	55.8

Pearsons chi-square = 28.58, d.f. = 8, p =0.000.

**Table 37:** Whether landholders have adopted legume rotations by cluster group.

Cluster group	Have adopted legume rotations (%)		
	No	Partly	Yes
1	42.3	3.8	53.8
2	34.2	15.8	50.0
3	24.1	34.5	41.4
4	70.7	9.8	19.5
5	14.3	28.6	57.1
<b>All respondents</b>	40.6	17.5	41.9

Pearsons chi-square = 33.15, d.f. = 8, p =0.010.

**Table 38:** Whether landholders have applied lime and/or gypsum over the past five years by cluster group.

Cluster group	Application of lime and/or gypsum over past five years (%)			
	None	Some paddocks	Most paddocks	All paddocks
1	34.5	27.6	31.0	6.9
2	15.0	40.0	45.0	
3	13.8	34.5	51.7	
4	31.8	38.7	29.5	
5		31.6	68.4	
<b>All respondents</b>	21.1	35.4	42.3	1.2

Pearsons chi-square = 26.67, d.f. = 12, p =0.009.

Other practices which were significantly different between groups at the 10% confidence level ( $p < 0.10$ ) include use of GPS for precision cropping, use of earthworks to control soil movement and use of automated irrigation control.

## Profiles of cluster group members

In the following section the characteristics of each of the groups' members are summarised individually.

### *Characteristics of the 'concerned but unengaged' group (Group 1)*

Members of the 'concerned but unengaged' group (Group 1) are so named because they have a relatively high interest in NRM issues yet also have relatively low adoption rate of CRPs. Members of this group had the highest ratings of concern about the health of the natural environment in their region, and relatively high ratings of concern about the health of the natural environment on their own property.

Group 1 includes the lowest proportion of respondents that listed 'agriculture' as their primary purpose for owning rural land at forty percent of the group. The remaining proportion of members includes hobby farmers or residential landholders (22% each), and 'conservation' landholders. This group has twice the proportion of 'conservation' landholders of any of the other groups which is consistent with their high interest in NRM matters. They also have the smallest landholdings on average.

Members of the 'concerned but unengaged' group:

- Generate the lowest proportion of their income from their property, have the lowest proportion of members reporting a profit from property enterprises in 2004/2005 and support the least number of people with this income;
- Have lived on rural properties, in the local district and on their current properties for the shortest period of time;
- Have the highest proportion of members with postgraduate formal education qualifications; and
- Have a high ratio of female members.

Less than ten percent of members of this group have prepared a property management plan, attended a short course on property management or participated in a government NRM program.

Members of this group rate 'media sources' of information about property management as the most useful, and trust environment groups (including Landcare groups) as much as their neighbours.

Members of Group 1 have an average of more than half their landholding under native vegetation. They have the highest score on the 'engagement index' for native vegetation management and a high score on the 'interest index' for native vegetation, making them very similar to the members of Group 5 in regard to this aspect of property management. A high proportion of members of this group have encouraged regrowth of vegetation and gather non-timber forest products on their land, yet a relatively low proportion have obtained a map classifying their forest types from the Queensland Environmental Protection Agency.

### *Characteristics of the 'multiple objectives' group (Group 2)*

The 'multiple objectives' group (Group 2) was named as such because they have a relatively high level of interest in NRM issues together with a relatively high level of engagement in the adoption of currently recommended property management practices. More than seventy percent of this group reported their primary purpose of landownership was for agriculture, which is less than the other two groups (Groups 3 and 5) dominated by 'agricultural' landholders, but substantially more than Groups 1 and 4 with less than fifty percent. The balance of non-agriculture group members is split between the purposes of 'hobby farms', 'conservation' and 'residential', each comprising 8-10% of its members.

Of the 'agricultural' members of Group 2, approximately twice as many undertake solely cropping enterprises compared to grazing enterprises. Their farm sizes are the smallest of the groups dominated by agricultural landholders. Members of the 'multiple objectives' group reported undertaking approximately forty hours per week of on-property work, and fifty percent reported making a profit in 2004/2005, which provided an average of fifty percent of their income. A relatively high proportion (23%) of members of this group reported a formal education level of primary schooling.

Only 45% of the 'multiple objectives' group have prepared a property management plan compared to 65-75% of the other 'agriculture' groups, and only 15% use an environmental or farm management system compared to 45-50% of the other 'agricultural' groups. Members of Group 2 have a relatively low level of concern about the health of the natural environment on their own property and moderate concern about the health of the natural environment in their region.

Members of the 'multiple objectives' group rated the three scales for property management goals ('to build business', 'to improve the environment' and 'family and lifestyle') as equally important. They reported they are equally unlikely to be considering expanding their operations or selling their property. They rated 'finance institutions and family' as the most useful source of information to assist property management decisions followed by 'media sources'. The members of this group have moderate levels of trust in 'environmental groups', significantly higher than those in the 'production orientated' and 'disconnected and conservative' groups (Groups 3 and 4).

With an average of approximately one-third of their landholdings under native vegetation, the members Group 2 have a relatively high level of interest and engagement in native vegetation management. In this regard the group stands out for their confidence in being able to access information about vegetation management and faith that sustainable timber production can be carried out on their landholdings. Approximately sixty percent of landholders in this group have encouraged regrowth of native vegetation and forty percent have a map of remnant vegetation on their land.

In terms of their adoption of recommended grazing and cropping practices, Group 2 is consistently third ranked after the members of Groups 4 and 5 in adoption rates.

### *Characteristics of the 'production orientated' group (Group 3)*

The 'production orientated' group (Group 3) was so named because while they currently report a high level of engagement in currently recommended practices, members also report low interest in NRM issues. A very high proportion of the 'production orientated' group listed 'agriculture' as the primary purpose for landownership (94%). Approximately 75% of the members of this group have some cropping land and have the second largest property sizes. Members of Group 3 report working the longest hours per week on their property (up to 53 hours), have the highest proportion of profit making in 2004/2005 (69%) and are the most reliant on property enterprises for income (at 64% of household income).

A small proportion of this group has formal education ending at primary school level, and small proportions with postgraduate education levels. This group has the smallest ratio of female members. They have lived on rural properties, in the local district and on their current properties for longer than any other group except the members of Group 5.

Members of Group 3 reported the highest rates of participation in short training courses, preparation of property plans and use of environmental or farm management systems. They further report the highest proportion to undertake pest and weed control, and the second highest rate of participation in government NRM programs in the last five years. Concern about pests and weeds dominates this Group's concerns regarding on-property NRM issues, while concern about the viability of agriculture dominates their concerns in regard to rural development issues. Building their business is their most important property management goal, although they were the group most likely to be planning to sell their property in the future. The most important information sources for this group are 'financial institutions and advisors' and 'family', followed by 'enterprise groups'. Their trust is highest for their neighbours, followed by 'productivity groups' such as the BSES Limited and the productivity boards. They had the lowest trust of all groups in the State Government agencies and 'environmental groups'.

With regard to native vegetation management, members of this group reported very low levels of both engagement and interest. They have the smallest proportion of their properties covered by native vegetation (15%), although just over half reported they have encouraged vegetation regrowth. None of these group members reported gathering non-timber forest products from the vegetation areas. Their antipathy toward native vegetation is further illustrated by the fact they have the highest rate of agreement with the statements that they would 'prefer to clear their forests' and that having forest areas 'decreases the aesthetics and value' of their properties.

Members of the 'production orientated' group report relatively high levels of adoption of CRPs in the cropping and grazing industries, and appear to be confident in managing the impacts of these practices although they are less convinced than others about the need for them.

### *Characteristics of the 'disconnected and conservative' group (Group 4)*

The 'disconnected and conservative' group (Group 4) is the largest group in the sample and includes 127 (40%) of the survey respondents. This group was so named because they have the lowest interest in NRM issues and engagement in utilising CRPs. Within this group, fifty percent of landholders listed 'agriculture' as their primary purpose for landownership, followed by one quarter 'residential' landholders, almost twenty percent hobby farmers and the remainder the 'other' category which includes a variety of land uses. Thus the members of this group are, together with the 'concerned but unengaged' group, the majority of 'residential' landholders in the overall sample.

Members of Group 4 have the second smallest average landholdings of all the groups and have the second lowest dependence on their property for income generation (above the 'concerned but unengaged' group – Group 1). Approximately 25% report making a profit in 2004/2005 and generate an average of 25% of their annual income from their property enterprises. Members of this group work an average of 26 hours per week on their property. They have also been living on rural properties, in their local district and on their current property for the second shortest time on average compared to the other cluster groups. In keeping with this pattern, Group 4 has the second least number of people living on the property and support the second least number of people from property enterprises. Approximately one-third of the members of this group are female which, together with the 'concerned but unengaged' group, is double the proportion of the next highest group (the members of Group 5).

In terms of their engagement in NRM activities, the 'disconnected and conservative' group has:

- The equal lowest proportion who have undertaken a short course;
- The lowest proportion who use an environmental management system;
- Had no involvement with government NRM programs in the past five years;
- Reported involvement in pest and weed management; and
- The lowest proportion of members who have prepared a property management plan.

Members of this group have the lowest scores of importance for all of the scales relating to both property NRM issues and regional development issues. Their lack of motivation with respect to property management is illustrated by the fact that they are least likely to be considering expanding their business and have the lowest scores for all scales relating to property management goals. They further have the lowest scores for all scales relating to the usefulness of information sources to assist property management decisions and the lowest or equal lowest ratings of trust in other people and institutions.

While members of the 'disconnected and conservative' group have an average of 54% of their property under native vegetation (which is equal highest), they have the lowest score on the interest in native vegetation index of all the cluster groups. This group has the lowest proportion of landholders who have encouraged regrowth of vegetation, the fewest members who have maps of their vegetation types and the second lowest proportion who gather non-timber forest products on their properties.

In terms of currently recommended grazing practices, the 'disconnected and conservative' group has the lowest proportion of members who use soil testing to determine fertiliser requirements. Only 25% of the members of this group have cropping land. Group 4 has the lowest proportion of members with cropping land who have adopted minimum tillage, soil testing, legume rotations and equal lowest proportion who have applied lime or gypsum in the past five years.

### *Characteristics of the 'well-connected and progressive' group (Group 5)*

The 'well-connected and progressive' group (Group 5) are so named as they have high levels of interest in NRM issues and engagement in CRPs.

Ninety percent of the members of this group listed 'agriculture' as their primary purpose for property ownership, half of whom are specialist croppers, and a further 20% of whom have mixed cropping and grazing enterprises with no hobby farmers. This group comprises only ten percent of the sample. Group 5 gave the highest average ratings of usefulness for information, have the highest participation in NRM groups and high average participation in other groups, as well as high levels of trust in other people and agencies operating in the region.

Members of this group have lived the longest time on average on rural properties and on their current property, and equal longest time in the local district. They have the largest sized properties on average, although there is a great deal of variation in property sizes. They work an average of fifty hours per week on the property, with approximately fifty percent reporting a profit in 2004/2005, and use property enterprises to provide approximately half of their income. This group also has the highest number of people who live on the property and support more people than those living on the properties, implying that many of these landholders employ extra labour. Nearly twenty percent of the members of this group are female. This group has the second highest proportion of members with postgraduate degrees and almost forty percent with a degree or diploma.

Approximately 85% of the members of the 'well-connected and progressive' group have attended a short course, and similar proportions have completed or are preparing a property plan. Sixty percent of members of this group have participated in a government NRM program over the past five years which is double the proportion of the next highest group (Group 3).

In terms of property management goals, members of this group rated 'improving the environment' highest of the three scales. They have the highest score for the property management intention 'to expand the business' and the highest scores for the usefulness of all potential information sources to aid decision making. They further gave the highest ratings of trust in all people and institutions.

While this group has an average of only 25% of their property under native vegetation compared to the 44% across all groups, they have the highest score regarding their 'interest in vegetation management index' and high levels of engagement in native vegetation management CRPs. Group 5 has the highest proportion of members who have encouraged growth of native vegetation and who have a map of their property's vegetation types.

The 'well-connected and progressive' group has a high proportion of members with grazing enterprises that use soil testing for determining fertiliser requirements and who use controlled grazing in all paddocks. Sixty-five percent of this group have some cropping land with 90% having adopted the use of soil testing and minimum tillage, and 85% also use legume rotations. All the members of this group with cropping enterprises reported applying lime or gypsum to their fields over the past five years.

## Implications for NRM policies and programs

There are a number of implications arising from the analyses described in this report.

To start with, the 'disconnected and conservative' group (Group 4) is the largest group, comprising forty percent of the overall sample. This means that while this group would be difficult to target for behaviour change programs, some effort needs to be made to raise their knowledge (awareness) of the broader NRM implications of their property management and the pressures on the natural environment. Changing the behaviour of this group is unlikely to be achieved in the short term given their lack of awareness about and interest in NRM, together with their low levels of trust in others, low use of external information sources and lack of motivation with respect to their landholdings.

Awareness raising and attitude strengthening campaigns (to convince landholders of the practicality of CRPs) are required to improve the interest of the 'production orientated' group (Group 3). Maintaining the relatively high engagement level of this group is likely to be best achieved through continued support for short courses run by industry groups (which they trust more than other agencies) and through targeting pest and weed management, the only NRM issue which concerns them to any great extent. It is also important to continue to supply credible evidence to this and other groups that there are connections between farm practices and environmental health, and more specifically that the adoption of CRPs does result in marked improvement in the health of natural resources.

Converting the high interest levels of the 'concerned but unengaged' group (Group 1) is likely to pose some challenges for those promoting improved practices, as many of the members of this group are not full-time farmers and will face time constraints and not be available during standard working hours. Members of Group 1 place a fair degree of trust in 'media' information sources (including newspapers, radio and the internet) and could be contacted through these channels. Together with the 'multiple objectives' group (Group 2), these landholders have a relatively high level of interest and engagement in vegetation management practices and this could be a useful topic through which to engage their interest in other aspects of property management. Given the relatively high levels of trust of these groups in 'environmental groups' (which include Landcare groups), these landholders could be targeted by Landcare groups.

## Future research activities

The next stage of this research will involve using personal interviews with landholders to test their reactions to the framework proposed for use in determining the allocation of funding under the Federal Governments' Reef Rescue program<sup>5</sup>.

The Reef Rescue program will form a central component of the NRM funding for the Wet Tropics region over the next five years. It also represents one of the first times that government NRM programs have explicitly developed 'codes of practice' for rural industries, in conjunction with the industries themselves, which are likely to be integral to the process used to manage NRM issues in the future.

Following on from this research, there is a need to develop provisional messages for raising awareness and increasing changes in attitudes, together with policies and programs targeted to the various groups which can be tested with the groups using qualitative techniques such as focus groups and personal interviews. In particular, interviews and focus groups could concentrate on developing a better understanding of the motivations and barriers to targeted behaviours.

A preliminary assessment of these potential benefits and barriers are presented in Appendix D.

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<sup>5</sup> Information about Reef Rescue is available from <http://www.nrm.gov.au/funding/2008/reef-rescue.html>.

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## Appendix A: Steps in social marketing assessments

Following is a summary of the steps followed in the process of preparing a social marketing assessment (material from Kotler and Lee 2008). Included are details of sources of supporting information to support each step.

- Step 1:** Plan the background, purpose and focus of the project. Process described in the Wet Tropics Regional NRM Plan and background reports (FNQ NRM Ltd and Rainforest CRC 2004; McDonald and Weston 2004; Weston and Goosem 2004; Armour *et al.* 2004).
- Step 2:** Conduct a situation analysis. The socio-economic profile is partly covered in the Wet Tropics Regional NRM plan background reports (McDonald and Weston 2004; Weston and Goosem 2004; Armour *et al.* 2004). The full regional profile is based on the latest census data. Registration of agricultural operations is still required.
- Step 3:** Select the target markets. Describe the population of interest in a meaningful way, as presented in this report.
- Step 4:** Define the objectives and goals for the study. This can be drawn from the FNQ NRM Ltd and Rainforest CRC (2004) and the objectives established for the Reef Rescue program. Objectives can include knowledge objectives (i.e. awareness of the implications of various behaviours), attitudes objectives (i.e. belief that the desired behaviour will produce the desired results for the person) and behavioural objectives.
- Step 5:** Identify the competition (competing behaviours and attitudes), barriers and motivators (develop an in-depth understanding of landholders' perceptions of the efficacy of the proposed actions). This could be partly drawn from landholder survey (questionnaire) results, supplemented with personal interviews and focus groups.
- Step 6:** Craft the desired positions. What knowledge, attitudes and behaviours are being targeted? Covered in the Wet Tropics Regional NRM Plan (FNQ NRM Ltd and Rainforest CRC 2004).
- Step 7:** Develop a product, price, place and promotion strategies. The products could include types of incentive packages being offered or regulations being considered, as well as awareness raising campaigns. Price is the amount of incentive being offered and/or the opportunity cost of foregoing some behaviour (e.g. the pasture lost from fencing waterways). Place is where the behaviour occurs, and is predominantly on-property, but can include places where information can be disseminated. Promotion is the means by which the 'product' will be advertised.
- Step 8:** Develop a plan for monitoring and evaluation. This will depend on the objectives and goals set for the project and may include follow-up landholder surveys to assess changes in awareness, beliefs and behaviour over time.
- Step 9:** Organise a budget and funding partnerships.
- Step 10:** Develop the implementation plan.

## Appendix B: Preliminary assessment of the value of targeting segments from the perspective of the regional NRM group

The following section provides a preliminary assessment of the landholder groups identified in this report in relation to the criteria used to identify the 'value' (effectiveness and efficiency) of targeting particular groups as described by Andreasen (1995).

The second part of this section presents a list of the probable benefits and barriers to the adoption of CRPs by landholders, together with their 'competing behaviour'.

The following criteria were suggested by Andreasen (1995):

- **Segment size:** Described as a proportion of the sample;
- **Problem incidence:** The proportion of members who are not currently undertaking CRPs or are aware of issues;
- **Problem severity:** Described in terms of the proportion of members currently using CRPs compounded by (multiplied by?) the area of land managed by the landholder.
- **Defencelessness:** Perhaps more typical in appraisals of health programs. Relates to the types and quantities of resources controlled by the members;
- **'Reachability':** Relates to the level of trust in others and their use of information channels;
- **General responsiveness:** According to their 'stage of change', plus level of trust, participation in social groups and use of information channels;
- **Incremental costs:** Costs of reaching and influencing the segment;
- **Responsiveness to marketing mix:** Potential reaction to behaviour change programs; and
- **Organisational capacities:** How well the organisation understands this market and how well equipped they are for programs that will assist the development of that segment.

**Table 39:** Provisional assessment of the value of targeting the various cluster groups.

Assessment criteria	Group 1	Group 2	Group 3	Group 4	Group 5
Segment size	21%	19%	11%	40%	9%
Problem incidence	Medium	Medium	Low	Medium to high	Low
Problem severity	Medium	Potentially high	Potentially high	Medium	Low
Defencelessness	Low	Low	Medium	Medium	Low
Reachability	Medium to High	Medium	High	Low	High
General responsiveness	Medium	Medium	Medium	Low	High
Incremental costs	Medium	Medium	Medium	High	Low
Responsiveness to marketing mix	High	Medium	High	Low	High
Organisational capacities	High	Medium	High	Low	High

## Appendix C: Stages of change

The following section describes the six stages that people are thought to follow as they change their behaviour, summarised from Kotler and Lee (2008: 120-121), following Prochaska and DiClemente (1994):

- **Pre-contemplation:** People with no awareness or acceptance that a behaviour is causing any problems;
- **Contemplation:** Some problems are acknowledged and attempts are made to identify means to overcome them;
- **Preparation:** Alternative behaviours have been identified and people are preparing to take them up;
- **Action:** This stage refers to when people have recently adopted a behaviour (i.e. it is being trialled);
- **Maintenance:** The behaviour is becoming routine but there are still issues to be sorted out; and
- **Termination:** The behaviour is normalised and not questioned by the person.

The 'stages of change' theory is an alternative to other behaviour change theories including the theory of reasoned action and social learning theory. Kotler and Lee (2008) note that the stages of change are not necessarily linear. For example, people may reach a stage of 'preparation' or even 'action' before returning to a 'pre-contemplation' stage. As the theory of stages of change is simple, it has become popular with practitioners and widely adopted for the purpose of planning and administering public health promotion strategies. However, the theories are not without their critics (Bunton *et al.* 2000). Criticisms of the model include the lack of consideration given to the factors causing behaviours, the lack of consideration of the social context of behaviour, the lack of clarity about which stage people are up to and lack of linearity of the stages, the lack of explanatory value of the theory and the lack of rigorous testing of the plausibility of the theory.

Bunton and others (2000: 62) argue that the stage of change theory is used to '*...justify the existence of processes, not explain them*' (italics in original). They note that the theory is atheoretical rather than transtheoretical as it fails to resolve the differences in intervention strategies that can be constructed when other theoretical basis are applied. For example, Bunton and others (2000) note that social learning theorists reject the causal link between beliefs and attitudes and thus would not recommend trying to influence beliefs as a means of changing behaviour. On the other hand, the theory of planned behaviour (Ajzen 1991) holds that peoples' behaviour is a result of the their own belief that a particular outcome will occur, the sense of control they have over the situation balanced with their perception of the 'social norms' that relate to the behaviour in question. Practitioners applying this theory may strive to influence an individual's belief and those of their social group with the goal of eventually changing behaviour.

## Appendix D: Benefits sought and barriers to the adoption of recommended practices

The following table (Table 40) presents a preliminary assessment of the benefits, barriers and competing behaviours of the landholder groups described in this report based on the market structure analyses. These propositions were further explored in a series of interviews with landholders identified as belonging to these groups (Ertage and Shrestha 2009).

**Table 40:** Benefits sought and barriers to the adoption of recommended practices by cluster groups.

Market segment	Probable benefits sought	Probable barriers		Present/competing behaviour
		Internal	External	
Concerned but unengaged (Group 1)	<ul style="list-style-type: none"> <li>Improved lifestyle and environment.</li> </ul>	<ul style="list-style-type: none"> <li>Lack identification with 'agriculture' from some members;</li> <li>Lack of experience in land management in some cases; and</li> <li>Lack of labour and time to investigate or trial new practices.</li> </ul>	<ul style="list-style-type: none"> <li>Small or no agricultural enterprise for many;</li> <li>Low profitability of agriculture; and</li> <li>Lack of available training schemes for vegetation management.</li> </ul>	<ul style="list-style-type: none"> <li>Relatively low adoption of enterprise of CRPs; and</li> <li>Relatively high interest in vegetation management and adoption of vegetation management CRPs.</li> </ul>
Multiple objective (Group 2)	<ul style="list-style-type: none"> <li>Improved lifestyle, profitability and environment.</li> </ul>	<ul style="list-style-type: none"> <li>Smaller operations;</li> <li>Lack of labour and time; and</li> <li>Lack of belief in need for change?</li> </ul>	<ul style="list-style-type: none"> <li>Low profitability of agriculture; and</li> <li>Lack of available training schemes for vegetation management.</li> </ul>	<ul style="list-style-type: none"> <li>Moderate adoption of CRPs.</li> </ul>
Production orientated (Group 3)	<ul style="list-style-type: none"> <li>Improved security for continued agriculture production and income; and</li> <li>Recognition of stewardship and excellence in farming practices.</li> </ul>	<ul style="list-style-type: none"> <li>Lack belief in environmental degradation as a result of agriculture; and</li> <li>Low trust in non-industry information sources and agencies.</li> </ul>	<ul style="list-style-type: none"> <li>Low profitability of agriculture;</li> <li>Perceived antagonism; and</li> <li>Arrogance of 'urban based' values of decision-makers.</li> </ul>	<ul style="list-style-type: none"> <li>Adoption of behaviours that have broad support of peers and positive impact on farm financial viability; and</li> <li>High proportion of 'partial' adoption of CRPs.</li> </ul>
Disconnected and conservative (Group 4)	<ul style="list-style-type: none"> <li>Independence or freedom of decision making.</li> </ul>	<ul style="list-style-type: none"> <li>Lack belief in environmental degradation;</li> <li>Lack of participation in social groups; and</li> <li>Low use of external information and trust in others</li> </ul>	<ul style="list-style-type: none"> <li>Resentment of outside control of management practices; and</li> <li>Small or no agricultural enterprise for many.</li> </ul>	<ul style="list-style-type: none"> <li>Lack motivation for property management for either production or conservation purposes.</li> </ul>
Well-connected and progressive (Group 5)	<ul style="list-style-type: none"> <li>Improved environment, lifestyle;</li> <li>Improved security for agriculture; and</li> <li>Recognition of stewardship and excellence in farming practices.</li> </ul>	<ul style="list-style-type: none"> <li>None or few.</li> </ul>	<ul style="list-style-type: none"> <li>Low profitability of agriculture; and</li> <li>Lack of support for on-farm trials.</li> </ul>	<ul style="list-style-type: none"> <li>Have already adopted most CRPs; and</li> <li>High use of information and participation in social groups.</li> </ul>

## Further Information

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