

Questionnaire Design, Sampling Strategy and Preliminary Findings: The Wet Tropics region

Marina Farr, Lynne Eagle, Rachel Hay and Meryl Churchill



Questionnaire Design, Sampling Strategy and Preliminary Findings

The Wet Tropics region

Marina Farr^{1,2}, Lynne Eagle^{1,2}, Rachel Hay^{1,2}, Meryl Churchill¹

¹ College of Business, Law and Governance, James Cook University (JCU)

² TROPWater, JCU



Australian Government



Supported by the Australian Government's
National Environmental Science Program

Project 2.1.3 Harnessing the science of social marketing and behaviour change for improved water quality in the GBR: an action research project

© James Cook University, 2017



Creative Commons Attribution

Questionnaire Design, Sampling Strategy and Preliminary Findings: The Wet Tropics region is licensed by the James Cook University for use under a Creative Commons Attribution 4.0 Australia licence. For licence conditions see: <https://creativecommons.org/licenses/by/4.0/>

This report should be cited as:

Farr, M., Eagle, L. Hay, R., and Churchill, M. (2017) *Questionnaire Design, Sampling Strategy and Preliminary Findings: The Wet Tropics region*. NESP Project 2.1.3 Interim report. Report to the National Environmental Science Program. Reef and Rainforest Research Centre Limited, Cairns (100pp.).

Published by the Reef and Rainforest Research Centre on behalf of the Australian Government's National Environmental Science Program (NESP) Tropical Water Quality (TWQ) Hub.

The Tropical Water Quality Hub is part of the Australian Government's National Environmental Science Program and is administered by the Reef and Rainforest Research Centre Limited (RRRC). The NESP TWQ Hub addresses water quality and coastal management in the World Heritage listed Great Barrier Reef, its catchments and other tropical waters, through the generation and transfer of world-class research and shared knowledge.

This publication is copyright. The Copyright Act 1968 permits fair dealing for study, research, information or educational purposes subject to inclusion of a sufficient acknowledgement of the source.

The views and opinions expressed in this publication are those of the authors and do not necessarily reflect those of the Australian Government.

While reasonable effort has been made to ensure that the contents of this publication are factually correct, the Commonwealth does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication.

Cover photographs: Lynne Eagle

This report is available for download from the NESP Tropical Water Quality Hub website:
<http://www.nesptropical.edu.au>

Contents

Contents.....	i
List of Tables.....	iii
List of Figures.....	iv
Acronyms	v
Abbreviations	vii
Acknowledgements	viii
Executive Summary	1
1.0 Introduction	3
2.0 Survey development and sampling strategy	4
2.1 Survey development	4
2.2 Sampling design	9
2.2.1 Study area.....	9
2.2.2 Sampling	10
2.2.3 Pre-test of the survey	12
3.0 Data.....	13
3.1 Data collection	13
3.2 Preliminary results	14
3.2.1 Background information.....	15
Making decisions relating to land-management and farming on the main property	15
If joint/shared decision, who is involved.....	15
Other properties	16
Other properties' location and land use	16
Off-farm 'job'.....	17
Number of people living on the main farm/property	18
Main property characteristics and land uses.....	19
3.2.2 Personal goals and aspirations.....	21
3.2.3 Importance of different factors when making decisions about what to do on the farm / property.....	23
3.2.4 Life satisfaction.....	25
3.2.5 Grants, funding, workshops and training programs.....	27
Grants and financial assistance.....	27
Workshops and training programs.....	30
3.2.6 The most useful workshops or training programs and reasons they were useful	36

- 3.2.7 What could be done to make grants, training programs, workshops and/or extension activities work better for cane growers and graziers to help the meet their personal goals39
- 3.2.8 Extension support or training that cane growers and graziers would like to have in the future to help them make farm improvements.....44
- 3.2.9 Current practices (self-reported behaviour).....49
- 3.2.10 Other innovative practices to reduce nitrogen and/or run-off.....61
- 3.2.11 Land managers’ perceptions of top causes and pressures on water quality.....62
- 3.2.12 Demographic background.....66
- 3.2.13 Additional property characteristics68
- 4.0 Recommendations and conclusion69
- Appendix 1: Cane Grower Survey86

List of Tables

Table 1:	Survey question to test social desirability bias	9
Table 2:	Relative risk of degraded water quality to the Great Barrier Reef.....	9
Table 3:	Cane growers survey completed in the Wet Tropics region as at 20/04/2017	14
Table 4:	Respondent's decisions making parties (N=247)	15
Table 5:	Who is involved in join/shared decision on main property (N = 127)	15
Table 6:	Proportion of cane growers who owns or manage other properties (N=242)..	16
Table 7:	Other property location and land use by cane growers	16
Table 8:	Respondent and his/her spouse off-farm work employment.....	17
Table 9:	The distribution of number of people who live in the main farm/property (N=242)	18
Table 10:	Proportion of land managers who owns, manage, lease or both their main property (N=245)	19
Table 11:	Number of years land manager owns/managed his/her main property (N=240)	19
Table 12:	Main land-use on main property	20
Table 13:	Land-uses, which are most important to the financial viability and enjoyment on main property.....	21
Table 14:	Average revenue from the last year (N=243)	21
Table 15:	Personal goals to achieve on farm/property	22
Table 16:	Importance of various factors when making decisions on farm/property (N varies from 206 to 246)	24
Table 17:	Overall satisfaction with quality of life (N=244).....	25
Table 18:	Comments from land managers - Positive responses about quality of life.....	26
Table 19:	Comments from land managers about difficulties being a land manager	26
Table 20:	The proportion of respondents that applied for grants and/or financial assistance	27
Table 21:	Grants and financial assistance programs that cane growers applied for in the last 5 years and the main sources of information about the grants/assistance programs (Total number of applications = 341)	28
Table 22:	Grants and financial assistance programs usefulness for land management (Total number of applications = 341).....	29
Table 23:	Comments from cane growers about what they hoped to achieve with funding/grants from the Reef Rescue Program	30
Table 24:	The proportion of respondents that participated in workshops, training programs or field days (N=246)	30
Table 25:	Workshops and training programs that cane growers participated in the last 5 years and their usefulness for land management (Total number of participation 685)	32
Table 26:	Workshops and training programs that cane growers participated in the last 5 years and the main sources of information about the workshops/training programs (Total number of participation is 685).....	34
Table 27:	Cane growers' comments about the most useful workshops and training programs	36

Table 28:	Cane growers’ positive and negative comments about making grants, training programs, workshops and/or extension activities better to help them meet their personal goals	39
Table 29:	Cane growers’ other comments and suggestions	40
Table 30:	Cane growers’ comments about extension support and training	44
Table 31:	Cane growers other comments and suggestions about extension support and training.....	45
Table 32:	The amount of irrigated water that cane grower uses per hectare (N = 19)....	49
Table 33:	Irrigation scheduling tools used by cane growers (N=20).....	50
Table 34:	Attitudes and motivations associated scheduling irrigation (N=12).....	51
Table 35:	Rank of importance of whose advice cane growers follow most when scheduling irrigation (N= 20)	52
Table 36:	Different ways to calculate fertiliser application rates (N=245)	53
Table 37:	Attitudes and motivations associated with calculating fertiliser rates (N varies between 212 and 221)	54
Table 38:	Rank of importance of whose advice cane growers follow most when calculating fertiliser application rate (N=181)	56
Table 39:	Practices for handling run-off from rainfall and irrigation (N=243)	57
Table 40:	Attitudes and motivations associated with handling run-off from rainfall and irrigation (N varies from 184 to 248).....	58
Table 41:	Rank of importance of whose advice cane growers follow most when handling run-off (N= 120)	60
Table 42:	Practices listed by the respondents as innovative.....	61
Table 43:	Land managers’ perceptions of water quality in local streams, rivers, and waterways (N=246).....	62
Table 44:	Land managers’ perceptions of the top causes of poor water quality locally ..	63
Table 45:	Cane growers and graziers’ comments about water quality	64
Table 46:	Land managers’ perceptions of cane growing/grazing industry and its role in the declining health of the GBR (N=243)	64
Table 47:	Land managers’ perceptions.....	65
Table 48:	Demographic characteristics of cane growers.....	66
Table 49:	Age of respondent (N=247)	67
Table 50:	Highest level of education completed by respondent	67
Table 51:	Average cane yield per hectare (per acre) (N=224)	68
Table 52:	Great Barrier Reef 2016 Media coverage examples	72
Table 53:	Network concepts relevant for natural resource management (adapted from Prell et al., 2009, p. 505) + indicates positive effect, - indicates negative effect	76
Table 54:	Characteristics of the dominant personality Styles (reproduced from Shrapnel and Davie, 2001)	77

List of Figures

Figure 1:	Mapping the questionnaire to the Theory of Planned Behaviour	6
Figure 2:	Social network Analysis Example: ‘Sociogram’ of 24 people.....	75

Acronyms

APEN	.....	Australasia-Pacific Extension Network
ACDC	.....	Agricultural Chemicals Distribution Control
ACFA	.....	Australian Cane Farmers Association
B	.....	Behaviour
BB	.....	Behavioural Belief
BBIFMAC	.....	Burdekin Bowen Integrated Floodplain Management Advisory Committee
BI	.....	Behavioural Intentions
BMP	.....	Best Management Practice
BSES	.....	Bureau of Sugar Experiment Station
BIRRR	.....	The Better Internet for Rural, Regional and Remote Australia
CB	.....	Control Belief
CEO	.....	Chief Executive Officer
CRM	.....	Customer Relationship Management
CSIRO	.....	The Commonwealth Scientific and Industrial Research Organisation
DAFF	.....	Department of Agriculture and Fisheries
DEHP	.....	Department of Environment and Heritage Protection
DERM	.....	Department of Environment and Resource Management
DNRM	.....	Department of Natural Resources and Mines
DoEE	.....	Department of the Environment and Energy
DPI	.....	Department of Primary Industries
DSITI	.....	Department of Science, Information Technology and Innovation
EEF	.....	Enhanced Efficiency Fertiliser
EU	.....	European Union
GBR	.....	Great Barrier Reef
GBRMPA	.....	Great Barrier Reef Marine Park Authority
GBRWHA	.....	Great Barrier Reef World Heritage Area
GCTB	.....	Green cane trash blanket
GES	.....	Genetic evaluation system
GPS	.....	Global positioning system
HCPSL	.....	Herbert Cane Productivity Services Limited
JCU	.....	James Cook University
IWM	.....	Integrated Weed Management
MAS	.....	Mossman Agricultural Services
MLA	.....	Meat & Livestock Australia
NB	.....	Normative Belief
NESP	.....	National Environmental Science Programme
NMP	.....	Nutrient management plan
NRM	.....	Natural Resource Management
NQ	.....	North Queensland
PC	.....	Personal computer
QLD	.....	Queensland
QOL	.....	Quality of life
QRAA	.....	Queensland Rural Adjustment Authority
RCD	.....	Ratoon stunting disease
R&D	.....	Research and development

RR	Reef Rescue
SDB	Social desirability bias
SEM	Structural equation model
SLA	Service Level Agreement
SNA	Social Network Analysis
SRA	Sugar Research Australia
SRDC	Sugar Research and Development Corporation
ToPB	Theory of Planned Behaviour
TCPSL	Tully Cane Productivity Services Limited
TMR	Transport and Main Roads
UNESCO	The United Nations Educational, Scientific and Cultural Organization
WHS	Work Health and Safety
WQ	Water quality
WPO&S	Work Place Health and Safety
WT	Wet Tropics
WTSIP	Wet Tropics Sugar Industry Partnership

Abbreviations

ac	Acre
approx.	approximately
ha	hectare
km	kilometre
M	million
ML	megalitre
m	metre
mm	millimetre

Acknowledgements

This project is supported through funding from the Australian Government's National Environmental Science Program (NESP). We would like to acknowledge the invaluable contribution of all those who offered their time to this project – responding to emails, reading through and commenting on questionnaires, participating in workshops, and sharing their knowledge and expertise with us. We would like to say a special thanks to Peter Chase, Carole Sweatman, Scott Crawford, Angela Cameron, Emma De Smet, Jeanette Durante, Jean Erbacher, Peter Gibson, Margaret Gooch, Billie Gordon, Nyssa Henry, Colleen James, David Low, Fiona McCartney, Kevin McCosker, Brigid Nelson, Adam Northey, Scott Robinson, Carlie Rocco, and Natalie Stoeckl.

We also would like to say a very special thanks to our interviewers from the Wet Tropics Sugar Industry Partnership Extension Team (WTSIP). Including Caroline Coppo, Daryl Parker, Don Pollock, Tim Liebelt, Joe Rhodes, Bob Stewart, John Tomlin, Alex Lindsay, Jarrod Sartor, and Suzette Argent for their effort and professionalism during the data collection process and to the Terrain and WTSIP for their administrative support.

We wish to extend our sincere appreciation to all cane growers in the Wet Tropics region who took the time and effort to complete our survey at such a busy time of year – without such input the project could not have gone ahead.

Executive Summary

This report focuses initially on the survey development and the sampling design of a survey delivered in the Wet Tropics and the Dry Tropics. It then provides a preliminary analysis of the initial data collected from cane growers in the Wet Tropics. Mainly in the form of descriptive statistics, (the results from the Burdekin region can be found in Farr et al., 2017b). It also provides provisional recommendations for key stakeholders regarding possible actions that should be considered in future interactions with land managers in the Wet Tropics.

When developing the questionnaires for cane growers in both the Wet Tropics and in the Burdekin region, the questions were kept similar wherever possible, to enable comparisons between the case study areas (e.g. cane growers in Wet Tropics and cane growers in Burdekin). The final version of the questionnaire is included as Appendix 1.

The sample population in the preliminary analysis was obtained from a membership database of cane producers supplied by Terrain NRM. Each respondent was allocated a unique identifier to de-identify the data. The unique identifier will also allow the research team to track changes in responses across the three years and to analyse those changes.

The preliminary analysis captures people in the Wet Tropics region who are/have been engaged or partially engaged in water quality improvement or any other programs in the Wet Tropics (93.2%) and those who are not or have not been engaged in water quality or any other programs in the Wet Tropics region in the last 5 years (6.8%).

The insights from the preliminary analysis of the initial data collected in round one show that the growers:

- Have a mature profile - the median age of cane growers is 57 years, which is significantly greater than the median age of the Australian population (37 years).
- Own (65%) or own & lease (12%) their property.
- Have lengthy land management experience - (average of 32.7 years), often following earlier generations on properties: maintaining traditions and heritage is important (over 63% of respondents indicated this to be of the highest importance).
- Do not make decisions in isolation – family / extended family are commonly involved.
- Are positive about overall quality of life (>91%).
- Have no significant plans to change future practices (>95%).
- Do not believe their farming practice adversely affects water quality in local streams, rivers, and waterways (42%).
- Do not believe that the cane industry plays a significant role in the declining health of the GBR (49%).
- Tend to shift their blame related to water quality and the health of the Great Barrier Reef.

There is a need to 'sell the science' to gain acceptance of the cause-effect relationship between farming practice and water quality.

There is potential to extend the key role of extension officers to influence an increased uptake of BMP practices. The main ways in which they can be supported in their interactions with land managers include:

- Supporting innovators ('positive deviants').
- Ensuring that land managers see their expertise as valued and their voices heard.
- Facilitating sharing of ideas and practices.
- Building on the role of farms whose views are respected as information gatekeepers / disseminators / role models.
- Ensuring that all persuasive communications are integrated in terms of key messages.
- Developing strategies for minimising the impact of competing and conflicting messages.
- Incorporating social media strategies as part of an integrated communication strategy that centres on the information channels and platforms used and preferred by land managers.
- Incorporate long-term relationship management strategies based on customer relationship management and business-to-business marketing concepts.
- Utilise Social Network Analysis to identify:
 - (a) key information gatekeepers / opinion leaders who may help or hinder information dissemination and innovation uptake, and
 - (b) where individual extension officers may fit into various networks.
- Consider the use of farmer typologies in developing resources to aid extension officers in their interactions with land managers.

Note: The survey was delivered in both the Burdekin and the Wet Tropics region of Queensland, therefore, the survey development and sampling strategy (Section 2) and recommendations (Section 4) of this report include common content with Section 2 and 4 of the *Interim report - Questionnaire Design, Sampling Strategy and Preliminary Findings (The Burdekin region)* (Farr et al., 2017b)

1.0 Introduction

This report is associated with NESP Tropical Water Quality Hub Project 2.1.3 *Harnessing the science of social marketing and behaviour change for improved water quality in the GBR: an action research project*. It focuses firstly on the survey development for the project and the associated sampling strategy (Section 2). It then provides a preliminary overview of the initial data collected from cane growers in the Wet Tropics region, mainly in the form of descriptive statistics (Section 3). Section 4 presents the provisional recommendations and conclusion. The appendix provide supporting materials (e.g. copy of the questionnaire). A more sophisticated data analysis will be undertaken and reported on separately, after all of the data is collected and entered into a database.

2.0 Survey development and sampling strategy

2.1 Survey development

The survey was developed using information gathered from an initial literature review related to the science of social marketing (see Eagle et al., 2016 for more details) and from literature surrounding agriculturally relevant behaviours that impact water quality (see Churchill et al., 2017). Key determinants of pro-environmental behaviour in the agricultural sector (see Farr et al., 2017a) were also used to guide the development of the survey. Then an impact assessment and consultation with stakeholders and end-users was used to develop preliminary questions for the survey. When developing the questionnaire, all variables that were found to be significant in Theory of Planned Behaviour (ToPB) studies within the agricultural context were considered. The aim was to create the survey questions in such a way that the responses could be used to create variables for Structural Equation Modelling (SEM) or other similar analytical techniques.

The first draft of the questionnaire was then distributed to the team members for comments and suggestions. All subsequent drafts of the questionnaire were distributed to key partners and stakeholders in the Department of Environment and Energy (DoEE), Department of Environment and Heritage Protection (DEHP), Department of Science, Information Technology and Innovation (DSITI), NQ Dry Tropics, Terrain Natural Resource Management (NRM) and Great Barrier Reef Marine Park Authority (GBRMPA) for feedback and discussion. Each time all comments, suggestions and insights were incorporated into the draft to ensure that key partners and stakeholders were satisfied with the questions. The final draft was used to conduct a pre-test/pilot survey in October 2016. The pre-test/pilot provided us with an opportunity to determine, more precisely, which questions did and did not 'work'. The feedback from the pre-test was incorporated into the final questionnaire (see Appendix 1).

Which behaviours should be changed?

In behaviour studies such as this, survey development involves a number of steps. First, we needed to decide which behaviours should be changed to improve environmental quality. The literature review on agriculturally relevant behaviours that impact water quality relevant to cane growers in the Wet Tropics (see Churchill et al., 2017 for more details) identified various behaviours related to water quality (WQ) improvement in cane growing farming (e.g. fertiliser application, handling run-off). As such, we started with long lists of behaviours (for example: 17 questions from the cane industry including questions about green cane trash blankets, traffic management, row spacing, fallow management and in-crop tillage etc.) hoping that we could simply rank/prioritise each of the behaviours. However, the literature review (Churchill et al., 2017; Farr et al., 2017a) also highlighted the existence of complex interdependence between the behaviours implying that there was a need to look at particular key behaviours/practices. For instance, which behaviours are relatively more important to water quality improvement and which are important interactively. Key partners and stakeholders from the DoEE, DEHP, DSITI, NQ Dry Tropics, Terrain NRM and GBRMPA were consulted to refine the 'behaviour' questions. Consultation ensured confidence that data collected could be quantified and analysed using appropriate econometric techniques, and that it was meaningful to the stakeholders. We ended up with three behaviours/practices associated with cane growing activities.

Three final 'behaviours' considered for cane growers were:

- What irrigation scheduling tools do you use?
- How do you calculate fertiliser application rates?
- How do you handle run-off from rainfall or irrigation?

Which factors determine relevant behaviour?

The next step was to decide which factors would determine relevant behaviour. Using insights from the literature review with respect to the ToPB (see Farr et al., 2017a) we created questions that would allow us to construct variables often used in ToPB studies and to identify statistically significant determinants of all specific behaviours under consideration (e.g. attitudes, beliefs, social norms etc. toward a specific behaviour). The modified Theory of Planned Behaviour provided the conceptual base for key questions in the cane grower survey. A brief explanation of core sections of the questionnaire is provided below.

When developing the questionnaire, we sought to keep questions similar (to enable comparisons) between the case study areas (e.g. cane growers in the Wet Tropics and cane growers in the Burdekin region). Specific sections of the survey questions included:

- Socio-demographic background of participants (e.g. age, gender, cultural heritage, income, etc.).
- Background information of farm characteristics (farm ownership, number of years owned/managed the property, land-use etc.).
- Main goals, motivators and priorities associated with the farm (e.g. how health, family tradition, spending time with family and friends, financial situation, local community and environment are important when making decisions about what to do on a farm).
- Satisfaction with overall quality of life and the reason for that satisfaction.
- Attitudes towards grants, financial assistance, workshops and training designed to encourage adoption of practices and how useful they are to achieve personal goals.
- Current 'practices' (self-reported behaviours)¹, with specific focus on:
 - irrigation
 - run-off from rainfall and irrigation, and
 - calculation of fertiliser application rates
- Attitudes toward each practice/behaviour under consideration because in order to find highly significant correlation between attitude and behaviour, attitude needs to be measured towards that particular behaviour (Ajzen & Fishbein, 1980).
- Planning to participate in specific behaviour (e.g. calculating fertiliser application) next year, which will enable us to measure the expression of land managers behavioural intentions (Flick, 2013).
- The reasons and motivations for involvement in current practice/behaviour, and whose advice is most important when making decision to participate in current practice/behaviour.

¹ There are some arguments on how to measure behaviours. Most studies in environmental psychology use self-reported measures of behaviour and consider them as appropriate indicators of actual behaviours (Fuj et al., 1985). Other researchers found low correlation between actual and self-reported behaviour (Corral-Verdugo, 1997). Behavioural decision-making models usually rely on self-reported behavioural data, thus they may be vulnerable to self-presentational biases (Gaes, Kalle, & Tedeschi, 1978).

- Non-motivational factors such as lack of funds and financial assistance, lack of skills and environmental factors (e.g. drought) which will allow us to measure if a participant has actual control to perform the specific behaviour (Flick, 2013).
- Perceptions of contribution to water quality in local streams, rivers, and waterways compared to other concerns.
- Optional specific questions about net income earned from the property.

Most of the questions about motivations and general attitudes have been assessed on a 7-point Likert scale (=1 if extremely unimportant (irrelevant); =4 if neutral; =7 if extremely important (essential)). Attitudes, norms and beliefs towards a specific behaviour have been assessed on a 7-point Likert scale (=1 if strongly disagree; =4 if neutral; =7 if strongly agree). Satisfaction with overall quality of life was measured on scale from 0 (very unsatisfied) to 100 (very satisfied) (see Appendix 1, which contains copy of cane growers questionnaire).

Figure 1 demonstrates how the questionnaire is mapped to the ToPB.

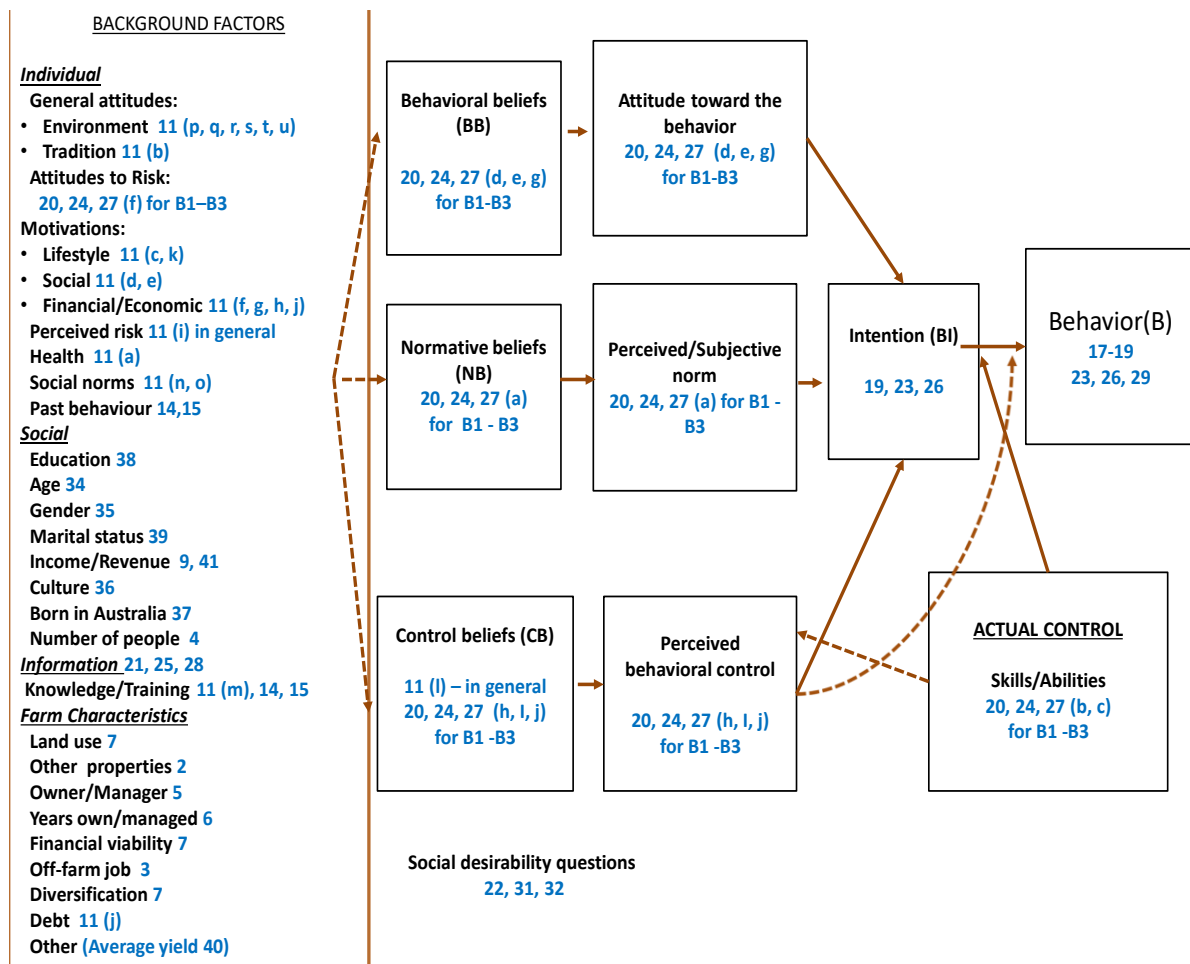


Figure 1: Mapping the questionnaire to the Theory of Planned Behaviour

Note: Letter next to the question number corresponds to a particular part of the question.

Behavioural beliefs (BB); Normative beliefs (NB); Control beliefs (CB); Behaviour intention (BI); Behaviour (B)

This study is longitudinal (White & Arzi, 2005) where survey questions were designed to collect data over three years (2016 – 2018). We will be asking the same land managers to complete the survey for two more years (i.e. three consecutive years in total). The survey was administered either as a face-to-face interview from January through to April 2017 and took up to one hour to complete. Face-to-face interviews are ‘a social activity where an interviewer asks each question and records all responses’ (Leggett et al., 2003, p. 562), thus responses are subject to social desirability bias (SDB) (Fisher, 1993). It has been empirically proven that participants can distort their responses trying to make them more socially desirable/acceptable or that they might try to give answers that an interviewer wants to hear (Atkin & Chaffee, 1972; Babbie, 1998; Leggett et al., 2003). Those distortions arise from what psychologists define as ‘cognitive dissonance’ – when a participant feels ‘some emotional discomfort’ (Loomis, 2014, p. 38) while revealing his/her actual answer (e.g. opinion, value, attitudes etc.). SDB ‘has been shown to influence individuals to over-report (under-report) desirable (undesirable) traits and behaviours across a wide range of contexts’ (Dalton & Ortegren, 2011, p. 75) including drug and alcohol use (Groves, 1989), level of cheating (Bernardi & Adamaitis, 2006), and self-reported ethical behaviour (Randall & Fernandes, 1991). The presence of the SDB can moderate, diminish or contaminate the true relationships between the dependent variable (e.g. behaviour) and independent variables (e.g. social and personal norms, attitudes towards environment etc.) (Fernandes & Randall, 1992).

One of the approaches to minimise social desirability bias and cognitive dissonance is to ask participants what they think others do instead of what they do. Participants are more likely to provide responses that are more realistic and as such eliminate social desirability bias (Lusk & Norwood, 2009; Norwood & Lusk, 2011). Anonymity is another way of trying to reduce socially desirable responses. Assuring respondents that their names will not be placed on the questionnaire and that their names will never be associated with the research findings are strategies commonly used by researchers but cannot completely eliminate social desirability response bias (Randall & Fernandes, 1991).

Trying to minimise social desirability bias, land managers have been informed that:

- all participants are anonymous to the JCU researchers
- only Terrain and Wet Tropics Sugar Industry Partnership (WTSIP) are involved in the database management (but they do not have access to un-aggregated data)
- each land manager has been allocated a unique identifier so that he/she could not be identified
- all contact details are kept strictly within the confines of the WTSIP offices and are stored separately from the data to ensure confidentiality, and
- participation is voluntary

In addition, two questions (shown below in

Table 1) were included to enable the researchers to test if the SDB is present.

Following Welters and Muysken (2008) we tested the data for the SDB and found it present for those particular questions. As such, the responses for self-reported desirable (undesirable) behaviour might also be over reported (underreported) and the SDB can potentially moderate the effect of independent variables (e.g. norms, attitudes) on the dependent variable (e.g. behaviour). Thus, our findings should be interpreted with an appropriate level of caution.

Table 1: Survey question to test social desirability bias

Social desirability question included in cane grower questionnaire

31. Roughly how many ML per hectare (acre) of water do you think most other cane growers in your region (not you personally) apply to their crops each year? **SKIP QUESTION IF NO IRRIGATED CROPS IN YOUR AREA**

_____ ML per hectare per year OR
_____ ML per acre per year

32. How many soil tests per 40 hectares of fallow or re-plant cane do you think that most other cane growers in your district (not you personally) did last year?

_____ (insert number of soil tests)

2.2 Sampling design

2.2.1 Study area

Two catchments were chosen as the case study areas:

- Wet Tropics region, and
- The Burdekin region

Table 2 gives a breakdown of the relative risk of degraded water to the Great Barrier Reef from the Northern Regions.

Table 2: Relative risk of degraded water quality to the Great Barrier Reef

Region	Overall relative risk	Priority pollutants for management		
		Nitrogen	Pesticides	Sediment
Cape York	LOW			
Wet Tropics	VERY HIGH	VERY HIGH	HIGH	
Burdekin	HIGH	VERY HIGH	VERY HIGH	VERY HIGH
Mackay	MODERATE	HIGH	VERY HIGH	
Whitsunday				
Fitzroy	HIGH		HIGH	VERY HIGH
Burnet Mary	UNCERTAIN			HIGH

Source: Brodie *et al.*, 2013 Scientific Consensus Statement, Chapter: 3

The Burdekin region produces both cattle and sugarcane, whereas the Wet Tropics mainly produces sugar cane. 'Sugarcane production has been the predominant agricultural industry for coastal Queensland since the middle of the 19th century' and over 85% of cane production in Queensland (QLD) occurs in the Burdekin, Mackay-Whitsunday, and Wet Tropics regions (Smith *et al.*, 2014, p. 1). Sugar cane is often located near the coastal areas and is grown with substantial use of nitrogen fertiliser (Thorburn *et al.*, 2013). Nitrogen losses from sugar cane activities can be discharged through 'deep drainage below the root zone, or as surface run-off'

(van Grieken et al., 2012, p. 2). As such, there is a little opportunity for surface run-off to be filtered through streams implying that pollutants flow quickly to the GBR lagoon.

Poor land management practices often result in land degradation and, consequently, have a negative impact on in-stream and/or downstream quality of water. Brodie et al. (2003) note that 70% of the sediment loads to the coastal areas are coming from relatively small areas of the GBR catchment which are close to the coast (e.g. the Wet Tropics, Mackay-Whitsunday catchments, sub-catchments of the Burdekin).

Wet Tropics region

The Wet Tropics (WT) region is located in Far North Queensland between Townsville and Cooktown and is recognised as 'Australia's biological crown jewels' (Benn, 2013, p. 10; Turnour et al., 2015). The region covers 22 000 km² with Cairns and Port Douglas being the main regional centres (DEHP, 2015). The Wet Tropics World Heritage Area is a part of the Wet Tropics catchments and is adjacent to the Great Barrier Reef World Heritage Area (GBRWHA) (Emtage & Herbohn, 2012). There are five major catchments in the Wet Tropics: Mossman and Daintree rivers, Tully and Murray rivers, Barron River, Russell and Mulgrave rivers and the North and South Johnstone rivers (Ashburner et al., 2012). The Wet Tropics area is known to be one of the highest rainfalls areas in Australia with some areas in the region receiving more than 4000 mm per annum. The wettest season in the region is between December and April, although rainfall events differ across the catchments. When rainfall is high freshwater discharges into the estuaries and the GBR lagoon are also high (Department of Natural Resources and Mines, 2014).

Rural land in the Wet Tropics is mainly used for growing sugar cane (Emtage & Herbohn, 2012). There are approximately 1343 land managers growing sugar cane in the region (Australian and Queensland governments, 2016). Sugar cane grows predominantly on the coastal floodplains and grazing activities occur in the west (DEHP, 2015). The WT region 'experiences extreme natural climate variability from one year to the next which influences crop yields and farming practices' (Ashburner et al., 2012, p. 76). The Wet Tropics is one of the key sugar cane growing regions in the GBR catchment and productivity varies from year to year depending on the rainfall level. It is usually low in wetter years and high in dryer years. In most years, the soil is very moist or even flooded for long periods of time, limiting farming operations from the end of January to March. Grazing and livestock production (e.g. dairy) are also substantial activities in the Wet Tropics region (Ashburner et al., 2012).

It is estimated that the dissolved nitrogen catchment loads in the Wet Tropics are approx. 11,000 tonnes per annum, which is much higher than in other catchments adjacent to the GBR. Fertiliser loss from sugarcane activities is the main source of those loads. In addition, 6,300 tonnes of the loads are resulting from human activities. Overall quality of water in the region is in moderate condition (DEHP, 2015).

2.2.2 Sampling

'A fundamental goal of survey-based research is to be able to generalise' research findings 'on the basis of the people that completed the survey' (Greiner & Miller, 2008, p. 27). As was mentioned earlier, this study is longitudinal (White & Arzi, 2005) and the survey questions were designed to collect data from land managers over three years in a row (2016 – 2018). One of the major disadvantages of longitudinal surveys is a steady decline in the response rate

(Cheshire et al., 2011). Longitudinal surveys are more burdensome for the participants than any other surveys. They are also more problematic in terms of initial recruitment of participants as well as difficulties with retaining them over time (Singer & Ye, 2013). Thus, we were aiming to survey as many cane growers in the research region as were willing to participate. To assist in retaining respondents an incentive was offered. Incentive offering is one tool that has been applied in many research areas to reduce the nonresponse component. In longitudinal studies, incentives have mainly been used as part of a motivational package for recruiting and retaining survey participants (Singer & Ye, 2013). Incentives have been found to:

- increase the response rates in all survey methods (e.g. Web, panel, cross-sectional) (Singer & Ye, 2013)
- increase the response rate when the size of the incentive increases but no evidence of how big an incentive should be (Goldenberg, McGrath, & Tan, 2009; Singer & Ye, 2013)
- increase the completion rate of web-based surveys (Göritz, 2006; 2010)
- have little or no effect on quality of responses (Singer & Kulka, 2002), sample composition (Cantor, O'Hare, & O'Connor, 2008) and response distribution (Singer & Ye, 2013)

Furthermore, monetary incentives (e.g. cash) do not produce differential measurement error in face-to-face or mail surveys (Ryu, Couper, & Marans, 2006).

'It seems clear that the use of respondent incentives is an important element of the strategy to minimize attrition for many longitudinal surveys . . . but we have limited knowledge of what the optimum strategies are for any given design and whether or how incentive strategies translate into improvements in the accuracy of estimation over the longer term' (Laurie & Lynn, 2009, p.230).

Consequently, trying to minimise non-response bias² we tried to keep the survey as short as possible and we provided additional incentives for potential participants – the study offered an opportunity to enter the draw to win a Drone or a Travel Voucher valued at \$1500.

Terrain NRM was contracted to help with data collection activities in the Wet Tropics region. Each respondent has been allocated with a unique identifying number, which will allow us to track changes in responses across the three-year period, while also enabling us to analyse those changes. Having a unique identifier allows Terrain to protect the confidentiality of participants. A detailed record of people who refused to be involved was kept during the data collection process to ensure that they would not be contacted twice.

Survey of Sugar cane growers

The data collection agreement with Terrain NRM was dependent upon the finalisation of a funding bid. Due to a range of factors, the finalisation of the agreement has taken longer than expected. Terrain NRM has now completed the Reef Trust III³ agreement, but the timing resulted in an unavoidable delay in data collection in the Wet Tropics region. In addition, the

² Non-response bias is the bias that results when participants differ in important ways from non-participants (e.g. land managers who are willing to do something for water quality improvement and those who care about water quality are more likely to complete the survey than those who do not care. Consequently, participants will differ in meaningful way from non-participants resulting in non-response bias)

³ Under this programme, the Government is providing \$56 million 'across four projects which will engage agricultural land managers operating within the Great Barrier Reef catchments to facilitate and increase the adoption of specific management practices to reduce pollutant loss' (Australian Government Department of Environment and Energy, 2016)

harvesting season was extended until late December 2016 making it challenging for cane growers to complete the survey. The delay in 2016 is unfortunate, but in the longer term it may ensure a much better outcome overall due to the involvement of extension officers appointed in the months prior to the data collection commencement.

The survey in the Wet Tropics region started in early January 2017. All cane growers in the Wet Tropics registered to a Terrain NRM database were given an opportunity to participate in the survey.

The survey was administrated according to strict ethical guidelines concerning:

- (a) **Anonymity and confidentiality** – while the interviewers knew the name and contact details of the participants while completing the interviews, all participants were anonymous to the JCU researchers. Terrain were involved in the data management process (e.g. working with contacting details of the land managers), where the land managers were allocated a unique identifier so that they could not be identified. In addition, all contact details stayed strictly within the confines of the Terrain offices.
- (b) **Voluntary participation** – Land managers received the survey information prior to the interview. An extension officer who explained the aim of the study and details of the survey contacted each land manager asking if he/she would like to be part of the study. Land managers were also informed that participation is voluntary and that they could stop at any time. As such, they had a choice to participate or to reject participation.
- (c) **No physical or psychological harm** – the interviewers were alerted to certain words, themes or ideas that may trigger a negative reaction in the respondents. The interviewers were requested to remain neutral and passive in their interview technique.
- (d) **Informed consent** – an information sheet was attached to the survey and the participant was required to verbally agree that they understood the research before agreeing to start to participate in the survey.

2.2.3 Pre-test of the survey

While the survey was conducted face to face, a pre-test survey was delivered online using Qualtrics survey software. A pre-test survey is often used to sample a small group of participants with similar characteristics as the population in the larger survey (Denzin, 1970). On 18th October 2016 a pre-test survey was activated and a link was emailed to a number of cane growers in the Burdekin and Wet Tropics regions to determine if the structure of the survey was easy to follow, if the questions were easy to understand and if the wording was appropriate and clear. We analysed the responses to refine the questions contained in the survey.

3.0 Data

3.1 Data collection

During the period from February to September 2016, the research team worked with key people from Department of Agriculture and Fisheries (DAF), DSITI, DEHP, Terrain NRM, NQ Dry Tropics, and Department of Primary Industries (DPI) to determine the best way in which to collect data. Initially all groups were aiming to combine data-collection efforts with other regular data collection activities (specifically, those sessions conducted annually), which capture information about land management practices. However, due to a number of factors such as a delayed harvest season, conflicting collection times between key groups that were related to specific times in the production cycle and delays related to survey design, we were not able to combine our data collection in 2016 with other regular data collection activities.

During this same period, the research team developed and finalised the surveys based on feedback from numerous consultations with stakeholders and end-users (e.g. DoEE, GBRMPA, DISITI, DEHP, Terrain NRM, NQ Dry Tropics, DAF and other industry representatives). The working group discussed what to include in the questionnaires, specifically paying attention to questions that were already asked in other surveys, which behaviours should be analysed and appropriate ways to ask the questions. After each round of consultation, we incorporated the suggestions and recommendations made by key stakeholders and end-users to the surveys.

Working closely with stakeholders and end-users enabled us to develop a much more comprehensive and useful questionnaire, which will generate reliable and valuable information for project stakeholders, researchers, government agencies, and for land managers. This comprehensive survey can be used as a standard tool across the Wet Tropics region for future monitoring and evaluation.

At the very early stages of the project, the most appropriate method of data collection was discussed and a positive agreement with Terrain NRM was reached regarding the proposed methods and staffing for this data collection process in the Wet Tropics. The proposal from Terrain NRM and the sugar industry was to utilise the Wet Tropics wide network of extension officers to collect the data with growers via the questionnaire. This proposal was important for a number of reasons:

- the extension officers were already working with growers and many have a long term relationship with some growers, thus, we can better ensure repeat responses over three years
- the accuracy of answers will increase with responses provided through a trusted partner rather than a stranger
- it can be used as a great tool for building new relationships
- it ensures efficiency across the NESP and Reef Trust delivery
- the data can be more actively used by industry and by Terrain NRM during delivery of other programs in the region ensuring the “action research” outcomes

In early December 2016, Terrain NRM and WTSIP extension staff were contracted to collect data in the Wet Tropics region. Training of the WTSIP extension officers was undertaken on 14 December 2016. The research team provided one two-hour training session on how to

conduct the survey. JCU researchers led the training of extension staff with involvement of WTSIP to discuss the best ways to engage with landholders in the region. Terrain NRM and WTSIP accessed and compiled a data base list from an internal database to identify potential participants. The data collection process in the Wet Tropics commenced in early January 2017 and finished in late April 2017. Extension officers administered surveys through face-to-face interviews on their regular farm visits. We are still waiting on the data needed to calculate the response rate.

3.2 Preliminary results

This section of the report provides a summary of characteristics of the respondents and insights from preliminary analysis of initial data collected in round one (as at 20 April 2017). This analysis captures people who are/have been engaged or partially engaged in water quality improvement or any other programs in the Wet Tropics and those who are not or have not been engaged in water quality or any other programs in the Wet Tropics region in the last 5 years.

Two hundred and forty-eight cane growers completed the survey through a face-to-face interview (see Table 3).

Table 3: Cane growers survey completed in the Wet Tropics region as at 20/04/2017

<i>Cane growers (N=248)</i>		
<i>Number of people asked</i>	<i>Number of people completed</i>	<i>Percent of people completed – Response rate</i>
Awaiting confirmation of numbers	248	To be calculated once number approached is provided

Participants were asked to provide socio-demographic information about their age, education, marital status, cultural heritage and other information such as main and other properties that they might manage and own. It should be noted that not all participants answered every question. As such, the number of participants reported in the preliminary analysis below may vary.

3.2.1 Background information

Making decisions relating to land-management and farming on the main property

Land managers were asked about making decisions relating to land-management and farming on their main property. Nearly 43% of cane growers said that they share their decisions while 44% of growers said that they make decisions entirely on their own. Another 13% said that the majority of the decision-making is theirs (see Table 4).

Table 4: Respondent’s decisions making parties (N=247)

		<i>Percent of cane growers (%)</i>
Making decisions about land-management & farming on main property	Entirely my decision (i.e. individual)	44.13%
	Joint/Shared decision	42.91%
	Majority of decision is mine	12.96%

If joint/shared decision, who is involved

Of those growers who are sharing decisions, nearly 26% prefer to share the decision solely with their brothers and sisters (Note: *Respondents also mentioned Bananas, Cattle, On farm work, Papaya, Paw Paw, and Pepper were also mentioned by respondents as the most important activities to the financial viability
 **Category 'Other' include small crops, Quarry, and 'variable' as the most important activities to the financial viability
 ***Respondents also mentioned Cattle, exotic fruits, and fish farming were also mentioned by cane growers as the most important activities for enjoyment
 ****Category 'Other' include Quarry, Camping, Coffee, Small crops, Natural bush, Nursery, Natural forest, Diversified fallow - rice/peanuts as the most important activities for enjoyment

Fifty-nine percent of cane growers said that this year revenue is better than previous years (Table 14).

Table 14), while 28.4% consult with their spouses. Those who consult with their spouses also mentioned sharing advice with their parents, in-laws, children, and brothers and sisters. Seven percent of growers share the decision with both their spouse and their children. Eighteen percent of respondents consult with their parents, the other 12% selected that they make decisions with their children and another 7% consult with other parties including the property owner, supervisor, business partner, advisor and farm leadership team. Of those who consult with parents, 3% also mentioned of sharing advice with children, brother and sister and employees. The rest of growers (2.4%) share decision with other extended family (e.g. grandfather and in-law).

Table 5: Who is involved in join/shared decision on main property (N = 127)

	<i>Percent of cane growers (%)</i>
Brother/Sister	25.98%
Spouse	28.35%
Spouse/Children	7.09%

	<i>Percent of cane growers (%)</i>
Parents	18.11%
Children	11.81%
Other extended family*	2.36%
Other*	6.30%

*Grandfather, in-law

**include supervisor, advisors, assistant farm manager, partner, share farm agreement, farm leadership team, owner

Other properties

Over 31% of cane growers selected that they own, manage, and lease other properties (Table 6).

Table 6: Proportion of cane growers who owns or manage other properties (N=242)

	<i>Percent of cane growers (%)</i>
No	68.18%
Yes	31.82%

Other properties' location and land use

Of those cane growers, who own, manage, and/or lease other properties, nearly half (49.3%) use their land for growing sugarcane. Another 47% of respondents did not specify their main use of land on the other properties (

Table 7). More than one half of the properties (52.7%) are located in Gordonvale (13%), Babinda (11%), Mossman (7.3%), Innisfail (4%), Moresby (4%), Mourilyan (4%), Ingham (3.3%), El Arish (3.3%), and Walkamin (2.7%).

Table 7: Other property location and land use by cane growers

<i>Location</i>	<i>Number of properties</i>	<i>Percent of properties (%)</i>	<i>Land use percentage (%)</i>				
			<i>Sugar</i>	<i>Lease block</i>	<i>Banana</i>	<i>Grazing</i>	<i>Not specified</i>
Gordonvale	19	12.67%	4.0%				8.67%
Babinda	17	11.33%	11.33%				
Mossman	11	7.33%	2.0%				5.33%
Innisfail	6	4.0%	2.67%				1.33%
Moresby	6	4.0%	0.67%				3.33%
Mourilyan	6	4.0%	1.33%				2.67%
Ingham	5	3.33%	2.0%*				1.33%
El Arish	5	3.33%	0.67%				2.67%
Walkamin	4	2.67%					2.67%

Location	Number of properties	Percent of properties (%)	Land use percentage (%)				
			Sugar	Lease block	Banana	Grazing	Not specified
Aloomba	3	2.0%	2.0%				
Tully	3	2.0%	0.67%				1.33%
South Johnstone	3	2.0%	1.33%				0.67%
Silkwood	3	2.0%	1.33%				0.67%
Wangan	3	2.0%	2.0%				
Atherton	2	1.33%	0.67%				0.67%
Foresthorne	2	1.33%	0.67%				0.67%
Edmonton	2	1.33%	1.33%				
Tolga	2	1.33%					1.33%
Kurrimine Beach	2	1.33%		0.67%			0.67%
Mareeba	2	1.33%					1.33%
Miallo	2	1.33%					1.33%
Kennedy	2	1.33%	0.67%		0.67%		
Walter Level Estate	2	1.33%					1.33%
Other***	38	25.33%	14.0%**	0.67%		1.33%	9.33%
Total	150	100%	49.33%	1.33%	0.67%	1.33%	47.33%

Note: * Banana farming and cattle breeding were also mentioned as the main land use on other properties

** Banana farming were also mentioned as the main land use on other properties

***Location of other properties include Euramo, Fishery Falls, Green Hill, Halifax, Highleigh, Cairns., Lower Herbert, Mirriwinni, Mulgrave, Murray Upper, Upper Stone, Bartle Frere, Machnade, New Harbour line, Pine Creek, Craiglie, Kalbo. Yuruga, Daintree mainland, Belvedere, Bilyana, Camp CK (next door), Rocket Rd - 3 lots, Rocky Point, Abergowrie, Yarradunga, Bambaroo, Toobanna, Kurrimine Beach, Mena Creek, and Trebone

Off-farm 'job'

The majority of respondents (62%) and their spouses (50%) were not working off-farm (Table 8). However, when growers are working off farm, 27% are working more than 20 hours per week, away from the property. Similarly, when spouses are working off farm, 32% are working for more than 20 hours per week.

Table 8: Respondent and his/her spouse off-farm work employment

	Cane growers Percentage (%) (N=235)
No – do not work off-farm	62.13%
Yes, less than 20 hours per week off-farm	11.06%
Yes, more than 20 hours per week off-farm	26.81%

	<i>Spouse (cane grower)</i> <i>Percentage (%)</i> <i>(N=188)</i>
No – do not work off farm	50.00%
Yes, less than 20 hours per week off-farm	18.09%
Yes, more than 20 hours per week off-farm	31.91%

Number of people living on the main farm/property

The respondents were asked how many people live on their main farm/property. Thirty-two percent of cane growers said that only two people live on the farm, 13% and 14% of cane growers indicated that three and four people live at their property respectively. Just over 8% of participants said that no one was living on the property, which may relate to other properties that are leased or owned (see Table 9).

Table 9: The distribution of number of people who live in the main farm/property (N=242)

<i>Number of people</i>	<i>Percent of cane growers (%)</i>
0	8.26%
1	6.61%
2	32.64%
3	13.64%
4	14.88%
5	6.61%
6	3.31%
7	3.31%
8	4.13%
9	1.23%
10	2.07%
11	0.83%
13	0.41%
2 + children	0.41%
2 families	0.41%
3 families	0.41%
4 families	0.83%

Main property characteristics and land uses

The respondents were asked questions about the main property that they manage and/or own. Nearly 65% of cane growers said that they owned their own farm (Table 10) while 12% said that they owned and leased their property.

Table 10: Proportion of land managers who owns, manage, lease or both their main property (N=245)

	<i>Percent of cane growers (%)</i>
Own	64.90%
Manage	2.86%
Lease	3.27%
Share	4.08%
Own/Manage	4.49%
Own/Lease	12.65%
Own/Share	0.82%
Own/Manage/Lease	1.63%
Own/Manage/Share	0.82%
Own/Lease/Share	1.22%
Manage/Lease	2.86%
Manage/Share	0.41%

Number of years owned/managed the main property

Just over 50% of cane growers said that they have owned and/or managed their main property for a period of 10 to 35 years (see Table 11), while 7.5% have owned their property for more than 55 years. Respondents have considerable land management experience (average of 32.7 years).

Table 11: Number of years land manager owns/managed his/her main property (N=240)

<i>Years</i>	<i>Percent of cane growers (%)</i>
>5	5.83%
5-10	7.08%
10-15	10.42%
15-20	5.42%
20-25	14.17%
25-30	10.0%
30-35	10.42%
35-40	6.25%

40-45	9.17%
45-50	5.42%
50-55	8.33%
<55	7.50%

Main land use on the main property

The respondents were asked about the main use of land on their main property (see Table 12). Over eighty-seven percent of respondents said that sugarcane activities are the main land-uses on their main property. Growing tropical fruits, vegetables, nuts and tobacco were also mentioned by land managers as land uses on their main property.

Table 12: Main land-use on main property

<i>Land-use</i>	<i>Percent of cane growers (%)</i>			
	<i>Land use 1 (%) N=246</i>	<i>Lane use 2 (%) N=79</i>	<i>Land use 3 (%) N=16</i>	<i>Land use 4 (%) N=2</i>
Sugarcane	94.31%	89.87%	87.5%	100.0%
Tropical fruits (e.g. Paw Paw, Bananas)	1.22%	3.81%		
Grazing	2.03%	5.06%	6.25%	
Mix- Peanuts/Vegetables/Dairy	2.03%			
Tobacco	0.41%	1.27%	6.25%	

Land-uses that are most important to the financial viability of the main property and importance of enjoyment

Just over 72% of growers said that cane-growing activities were the most important use of land to the financial viability of their property and 65.5% said that they enjoy it the most. Grazing, breeding, growing and selling cattle was not an important land-use for the respondents, either financially or for enjoyment. Off-farm work was more important to financial viability (12.4%) than for enjoyment (5.3%). Cane farmers indicated that other land uses such as growing bananas, fruits (e.g. Paw Paw, Lime, Pineapples) and vegetables (e.g. Pumpkins, Spuds) were important to the financial viability of the farm as well as enjoyment (Table 13).

Table 13: Land-uses, which are most important to the financial viability and enjoyment on main property

<i>Activities</i>	<i>Percent of cane growers (%)</i>	
	<i>Importance to the financial viability (N=234)</i>	<i>Importance of enjoyment (N=226)</i>
Sugarcane	72.22%*	65.49%***
Sugar cane & off-farm	0.85%	2.21%
Grazing/Breeding, growing & selling cattle		2.66%
Bananas	4.27%	1.77%
Fruits	2.14%	2.65%
On Farm	2.99%	11.95%
Off-farm work	12.39%	5.31%
On farm/Off-farm	0.85%	2.21%
Vegetables	1.28%	0.88%
Fish farming	0.43%	
Other	2.14%**	3.54%****
None/Don't enjoy any	1.33%	

Note: *Respondents also mentioned Bananas, Cattle, On farm work, Papaya, Paw Paw, and Pepper were also mentioned by respondents as the most important activities to the financial viability

**Category 'Other' include small crops, Quarry, and 'variable' as the most important activities to the financial viability

***Respondents also mentioned Cattle, exotic fruits, and fish farming were also mentioned by cane growers as the most important activities for enjoyment

****Category 'Other' include Quarry, Camping, Coffee, Small crops, Natural bush, Nursery, Natural forest, Diversified fallow - rice/peanuts as the most important activities for enjoyment

Fifty-nine percent of cane growers said that this year revenue is better than previous years (Table 14).

Table 14: Average revenue from the last year (N=243)

		<i>Percent of cane growers (%)</i>
This year's revenue	Is better than previous years	58.85%
	Is about the same as previous years	27.98%
	Is worse than previous years	13.17%

3.2.2 Personal goals and aspirations

Land managers were asked about their two personal goals and aspirations for their farm/property, which are most important when they aim to achieve something on their farm.

Just over 18% of cane growers said that an increase in profitability and income was the main goal for their property; an increase in productivity (17.6%), financial security (16%), and viability

for future generations (9.8%) were also among their main goals (Table 15). The most important second goals for cane growers were long-term sustainability (22%), an increase in profitability and sustainable income (9%), an increase in productivity and efficient production (9%), and lifestyle (7.4%) (Table 15).

Table 15: Personal goals to achieve on farm/property

	Percent of cane growers (%)	
	<i>Personal goal 1</i> (N=244)	<i>Personal goal 2</i> (N=215)
Long-term sustainability	6.97%	22.33%
Profitability/Income*	18.44%	9.3%
Productivity**	17.62%	8.84%
Financial security***	15.98%	3.72%
Viability for future generations	5.33%	9.77%
Lifestyle/Happiness/Work balance	4.51%	7.44%
Expand the farm/Farm diversification	4.1%	6.51%
Pride/Family tradition	2.87%	4.65%
Pay off/Reduce debt	3.28%	0.93%
Keep farming the property	3.69%	3.72%
Sell farm/property	3.69%	0.93%
Retirement/Transition to retirement	2.05%	2.79%
Succession of farm business	1.23%	4.19%
Soil Health	2.87%	0.93%
Grow the best cane/Good crops	2.05%	0.47%
Trying new technologies/Learning more	0.41%	2.33%
Recognition of effort/outcomes	0.41%	2.33%
Higher sugar (CCS)	0.41%	1.4%
Low costs/Inputs	0.41%	1.4%
Buy my own farm/property	0.82%	
Efficiency		1.86%
Less regulations		0.93%
Other	2.87%****	3.26%*****
	100%	100%

* Sustainable income, productivity, satisfaction, and low costs were also mentioned by growers

** Efficiency, environmental sustainability, profitability, and reduce inputs and costs were also mentioned by growers

*** Financial viability, stability, financial independence, financial success, and family transfer were also mentioned by growers

****Category 'Other' (Personal goal 1) include responses such as 'fix up farm - buildings, tractor etc.', 'have farm 100% irrigable', 'I have achieved been 1st, 2nd, 3rd and 6th and over', 'survive the down turns/low sugar prices'

*****Category 'Other' (Personal goal 2) include responses such as 'achieve a fair price for sugarcane by products', 'better infrastructure', 'pest management', 'presentation', 'rid property of feral pigs', 'saving money to achieve a common goal', 'work ethics'

3.2.3 Importance of different factors when making decisions about what to do on the farm / property

Land managers were asked to indicate how important a range of different factors were, when making decisions about what to do on the farm / property (using a seven – point Likert scale from extremely unimportant =1 through to extremely important =7).

The most important factor was the physical & mental health of family (71.5%), followed by leaving the land/farm in better condition than it was when they first started managing it (69.4%). The third most important factor is being able to make their own decisions about farm/property (69.1%) and the fourth is maximising farm profits (income minus costs) (67%). The fifth most important factor was minimising sediment run-off and/or nutrient losses (65.8%) (Table 16).

Helping to safeguard local waterways was also mentioned as an important decision on the farm. Economic factors such as keeping a stable (steady) cash-flow (64%), servicing debt (55%) and minimising risk (53%) were also extremely important to cane growers. Interestingly, over 14% of cane growers indicated that having their efforts recognised by the wider community is extremely unimportant or unimportant to them while 27% were neutral about wider community recognition. More than half thought it was important to essential. Having enough time to pursue hobbies was also not that important for growers. Helping to safeguard local waterways was more important for decision-making on the farm/property than helping to safeguard the Great Barrier Reef.

Table 16: Importance of various factors when making decisions on farm/property (N varies from 206 to 246)

	Percent of cane growers (%)							
	Extremely unimportant (irrelevant)	2	3	Neutral	5	6	Extremely important (essential)	I do not know
Physical & mental health of family	.8	.4		1.6	3.7	22.0	71.5	
Family traditions and heritage	1.2	1.2	1.6	17.1	16.7	30.6	31.4	
Spending face-to-face time with family & friends	.4	.8	.8	4.1	12.2	35.0	46.7	
Keeping in contact with family & friends in other ways	2.5	.4	2.1	11.9	12.8	35.0	34.6	.8
Good relations with other farmers/graziers	.4		.4	2.8	15.4	43.1	37.8	
Keeping farm costs low	.8		.4	2.8	9.8	22.4	63.8	
Keeping a stable cash-flow	.8			.8	10.2	24.0	64.2	
Maximising farm profits	.8			1.6	6.5	24.1	66.9	
Minimising risk	.8		.8	3.3	14.2	27.6	53.3	
Servicing debt	2.9		2.1	10.4	5.0	23.3	55.4	.8
Having time to pursue hobbies	2.4	2.8	6.5	16.7	23.6	25.6	21.5	.8
Being able to make your own decisions	.8			.8	4.5	24.8	69.1	
Learning about & testing new ways of doing things		.4	1.2	2.0	10.2	43.5	42.7	
Sharing new ideas with others	1.2	.4	1.2	4.9	16.7	40.7	35.0	
Efforts recognised by the wider community	6.9	7.3	3.7	26.9	20.4	19.2	14.7	.8
Leaving the land/farm in better condition	.4			2.0	4.5	23.7	69.4	
Maintaining/improving water supplies & storages	2.4		.5	27.7	5.3	12.6	29.6	21.8
Minimising sediment run-off and/or nutrient losses	.4			2.5	3.7	27.6	65.8	
Helping to safeguard native plants & animals	.4			11.2	14.9	36.0	37.2	.4
Helping to safeguard local waterways	.4			2.5	7.0	34.2	56.0	
Helping to safeguard the GBR		.4	.4	4.1	8.6	27.2	59.3	

3.2.4 Life satisfaction

Land managers were asked to respond on a 100 point scale (0=very unsatisfied; 100=very satisfied) about their quality of life (QOL) to better understand factors that might influence decision making. Fifty-nine percent of cane growers were very satisfied and 20% were satisfied with their overall quality of life. Just over 4% were neutral and 3.8 unsatisfied or very unsatisfied with their QOL. The mean satisfaction with the QOL was estimated as being 78.6 indicating that the majority of land managers are satisfied or more than satisfied with their overall quality of life.

Table 17: Overall satisfaction with quality of life (N=244)

<i>Life satisfaction score</i>	<i>Percent of cane growers (%)</i>
0 (Very unsatisfied)	.4
10	.4
25 (Unsatisfied)	1.2
30	.4
40	.8
45	.8
50 (Neutral)	4.5
52.5	.4
55	.8
60	4.9
65	2.9
70	2.5
75 (Satisfied)	20.5
77	.4
80	13.1
82.5	1.2
85	14.3
90	12.7
92.5	.8
95	6.6
97	.4
97	2.5
99	.4
100 (Very satisfied)	7.0

The main reasons for feeling very satisfied were about good health and family, financial security, achievement, enjoyment and satisfaction. The respondents indicated that they have a good balance of work and lifestyle, profitability, and control over life.

Some of the supporting statements are in Table 18 below.

Table 18: Comments from land managers - Positive responses about quality of life

'Doing what I love'

'I enjoy my job, we are financially sound and we have a good family'

'You get from life what you put in. I believe the harder you strive the rewards follow. At 68 years of age I have the benefit of hind and appreciation of the opportunities offered and taken'

'Healthy, can take a day off, old enough not to care what people think of you'

'I am living the dream'

'Health, fitness in good shape now. Business is profitable'

'Only thing that would improve is retirement'

'In control of own life'

'Happy life - life has worked out well'

'I have worked hard and made some good decisions so I am now able to help others in my family'

'My QOL is excellent, peaceful and satisfying. I am happy here on the farm, my family and my husbands' family have farmed here since the early 1920's. It is a way of life subject to the whims of nature, and we have to be flexible accordingly. We must work around the things that try to intervene with the ebb and flow of farming. Cyclone Yasi reduced our tonnage cut by about 60%, but we had to roll with the threat and move on, taking 5 years to farm recovery, but probably taking 10 years to achieve the pre-cyclone financial situation'

Even though there were respondents who were very satisfied with their overall quality of life, some pointed out that there were difficulties in being a land manager (see Table 19).

Table 19: Comments from land managers about difficulties being a land manager

'I would like to work less and spend more time with family'

'Satisfied with my life but disappointed in the overall district attention to maintaining and improving the environment. Money speaks louder than anything else'

'My life has changed since the passing of my husband. I am new to farming and it causes some stress. Need to learn about farming'

'Could be 100% but not happy how treated by Government and regulations'

'Under pressure from regulation and politicianism'

'Reasonable health; still profitable but industry seems like a stone around my neck'

'Working 2 industries, both of which have declining returns. Increased stress'

'Happy generally - time poor don't like community pressures'

'Life is good but get tired from work'

Only 4% of cane growers were dissatisfied with their overall quality of life. The main reasons for dissatisfaction were strict government legislations, lack of income to support family, inability to be a full-time cane farmer and busy harvesting roster.

3.2.5 Grants, funding, workshops and training programs

Grants and financial assistance

Land managers were asked to tell us about the grants and financial assistance that they applied for to do things on their property. Sixty-nine percent of cane growers applied for three grants or financial assistance or less, 9% said that they applied for more than three grants or financial assistance and 22% said that they did not apply for any (Table 20).

Table 20: The proportion of respondents that applied for grants and/or financial assistance to do things on property (N=245)

	<i>Percent of cane growers (%)</i>
No, I did not apply for any	22%
Yes, I applied for 3 or less	69%
Yes, I applied for more than 3	9%

Land managers were asked to identify the grants and financial assistance programs that they have applied for in the past 5 years. They were also asked to select on a seven point scale (1= complete waste of time to 7=completely useful) the usefulness of the grant (Table 21 and Table 22). There were 341 applications in total. Some respondents applied for 2, 3 or more grants/financial assistance programs. The majority of grants and funding applications were successful (88.5%). Reef Rescue was the most popular (88% of total applications) (Table 21).

Table 21: Grants and financial assistance programs that cane growers applied for in the last 5 years and the main sources of information about the grants/assistance programs (Total number of applications = 341)

Information source	Grants and financial assistance programs									
	Percent of applications (%)									
	Reef Rescue (N=301)	Reef Trust Tender (N=12)	Innovation Grants (N=8)	RA (N=3)	Drainage (N=2)	Drought (N=2)	Other# (N=11)	Not Specified (N=2)	Total (N=341)	
Canegrowers Organisation*	40.18	0.88%	0.29%			0.59	0.88		42.82	
Extension Officer**	18.77	0.88%	0.59%	0.88	0.29		0.59	0.29%	22.29	
Media	5.28%	0.29%							5.57%	
TCPSL	3.82%		0.29%				0.29		4.4%	
Terrain	2.05%	0.29%	0.88%		0.29				3.52%	
MAS	1.47%	0.59%	0.29%						2.35%	
Growers' meetings	1.47%							0.29%	1.76%	
Productivity Services	1.47%	0.29%							1.76%	
HCPSL	1.47%								1.47%	
Common knowledge	1.47%								1.47%	
Industry	1.17%								1.17%	
Project Catalyst	0.59%								0.59%	
SRA	0.59%								0.59%	
Family/Friends	0.59%								0.59%	
Other***	4.99%						0.88		5.87%	
Not specified	2.93%	0.29%					0.59		3.81%	
Total	88.27	3.52%	2.35%	0.88	0.59	0.59	3.23	0.59%	100%	

* Canegrowers Grants Officer and Canegrowers Newsletter were also mentioned as information sources by growers

**BSES/SRA Extension officer was also mentioned as an information source

***Category 'Other' information sources include work, DNRM, DPI, EA, Farmer co-op, Fruit and Veg, Precision farming, QGCO, other farmers

#Category 'Other' grants and financial assistance programs' include Direct drill legume planter, Dr Brian Prov, FEAT, Herbicide sprayer, QLAA, Rural water use, CSR IT, Mossman Reef TMA, Project Catalyst, QRRA, SRDC, QRAA

A means analysis shows that the Reef Rescue funding was very useful for the applicants (M=6.35) (Table 22). The main sources of information about those grants and programs were Canegrowers organisation (42.8%) and extension officers (22.3%) (Table 22).

Table 22: Grants and financial assistance programs usefulness for land management (Total number of applications = 341)

<i>Grant/Financial assistance program</i>	<i>Usefulness score Mean</i>
RA	7.00
Drought	7.00
Drainage	6.50
Reef Rescue	6.35
Reef Trust Tender	6.00
Innovation Grants	5.29
Other	
Direct drill legume planter	7.00
Dr Brian Prov	7.00
FEAT	7.00
Herbicide sprayer	7.00
QLAA	7.00
Rural water use	7.00
CSR IT	6.00
Mossman Reef TMA	6.00
Project Catalyst	6.00
QRRRA	6.00
SRDC	6.00
QRAA	5.00
Not specified	-

Note: Usefulness of grants and financial assistance programs was measured using a seven – point Likert scale from 1 = ‘complete waste of time’ through to 7 = extremely useful

The most important things mentioned by cane growers that they hoped to achieve with Reef Rescue program included implements or tools that they were able to purchase and elements of practice change (see Table 23).

Table 23: Comments from cane growers about what they hoped to achieve with funding/grants from the Reef Rescue Program

<i>Implement/Tools</i>	<i>Practice change</i>
<ul style="list-style-type: none"> • Shielded sprayer • GPS • Compost turner 	<ul style="list-style-type: none"> • Provide farmer with a link to take up a farming practice by Providing funding to bridge the gap re allowing a farmer to Be financially inhibited to make the decision to change Practice. Normally farmer wouldn't be able to • Irrigation water run-off control • Demonstrable sustainability • Precision nutrient application • Put in trickle irrigation • Sustainability • Reduce residual chemical use • Making work economical • Stopped a lot of sediment run-off. Bought a leg implanter. Put in cover crops and used bevel rake with GPS to control Fertiliser instead of putting it straight on top of the land. Prevents run-off • Quality of water run-off to decrease it to nearly nothing

Workshops and training programs

Land managers were also asked about participation in workshops, training programs and extension activities in the last 5 years. The majority of cane growers stated that they had participated in workshops, training programs and extension activities (Table 24). Eighty-two percent of grower’s participated in five or less and nearly 9% of respondents participated in more than five workshops and training programs.

Table 24: The proportion of respondents that participated in workshops, training programs or field days (N=246)

	<i>Percent of cane growers (%)</i>
No, I have not participated in any	8.5%
Yes, I participated in 5 or less	82.5%
Yes, I participated in more than 5	8.9%

Cane growers were also asked to identify the workshops, training programs or other support activities such as field days and on-farm demonstrations that they have participated over the past 5 years. They were also asked to select on a seven point scale (1 = complete waste of time to 7= completely useful) the usefulness of the workshop, training program or field day.

Participants were able to select more than one workshop and therefore participated in 685 workshops, training programs or other support activities (Table 25). Some growers participated in 2, 3 or more workshops and/or training programs. Nutrient management (WTSIP) (30% of total participations) was the most popular and quite useful program (the mean usefulness score for this program was 6) (Table 25). Smartcane BMP (17%), AusChem (15%), Integrated Weed Management (WTSIP) (12%), and Drainage and Sediment Control (WTSIP/BMP) (4.5%) were also popular amongst cane growers. The most useful workshops and training programs were Digging Deeper (Terrain/ David Hardwick), Project Catalyst Growers Forum, Regen Agriculture, Diploma of Agriculture, and Land management Terrain (Table 25).

Table 25: Workshops and training programs that cane growers participated in the last 5 years and their usefulness for land management (Total number of participation 685)

<i>Workshops/Training program</i>	<i>Percent of total participation (%) N=685</i>	<i>Usefulness score Mean</i>
Field Day/Grower walk	2.19%	6.17
AusChem	15.47%	6.13
Soil Health (Smartcane BMP/SRA)	2.48%	6.13
Integrated Weed Management (WTSIP)	12.12%	6.08
Nutrient management (WTSIP)	30.07%	6.02
Climate Outlook Tools (WTSIP)	1.17%	5.88
Drainage & Sediment Control (WTSIP/BMP)	4.53%	5.83
Precision Agriculture (WTSIP)	1.61%	5.82
Smartcane BMP	17.23%	5.76
Work Place Health and Safety	1.02%	5.71
GPS Basics (WTSIP/TCPSL)	1.02%	5.43
Other	9.64%	
Digging Deeper (Terrain/ David Hardwick)		7.00
Project Catalyst Growers Forum		7.00
Regen Ag		7.00
Diploma of Agriculture		7.00
Land management Terrain		7.00
Water Use Management		6.5
Spray Technology (WTSIP)		6.33
Certificates*		6.25
Commercial Applicators Course		6.00
ACDC/ACDC Spray licence		6.25
Farm Business		6.00
Harvesting best practice		6.00
Productivity meeting		6.00
QCane Select		6.00
Rat baiting		5.5
Terrain Bio Fertiliser workshop		5.00
Reef Rescue/Reef Programme		5.00
Compass		3.00
Not specified	1.46%	
	100%	

*Subcategory 'Certificates' include Certificate III Chemical Application, Certificate III Herbicides, Certificate III Business Administration

Note: Usefulness of workshops and training programs was measured using a seven – point Likert scale from 1 = 'complete waste of time' through to 7 = extremely useful

The most important things mentioned by cane growers that they hoped to achieve with Nutrient management (WTSIP) were:

- More efficient fertiliser application
- Reduce nutrient run-off
- Reconfirm soil test interpretation
- Compliance and productivity
- Managing soil types
- Improve knowledge
- Looking for new ideas
- Better nutrients management
- Had to apply for grant
- Improve knowledge
- Comply with environmental requirements & save money
- Reduce nitrogen loss
- Better profitability

The main sources of information about these workshops and training programs were Canegrowers organisation (44.7%) and extension officers (15.6%) (Table 26 Table 26).

Table 26: Workshops and training programs that cane growers participated in the last 5 years and the main sources of information about the workshops/training programs (Total number of participation is 685)

Information source	Workshops and training programs															Total N=685
	Percent of participation (%)															
	Nutrient Management N=206	Smart cane BMP N=118	Aus Chem N=106	IWM N=83	Drainage Sediment Control N=31	Soil Health N=17	Field Days Grower Walk	Precision Ag N=11	Climate Outlook Tools N=8	GPS Basic N=7	WPH&S N=7	Other* N=66	Not Specified N=10			
Canegrowers organisation	43.20	60.17	39.62	49.40	61.29	17.65	13.33	72.73	50.0	85.71	57.14	25.76	20.0		44.67	
Extension officer	19.90	14.41	11.32	19.2	16.13	23.53	6.67		12.50	14.29	28.57	7.58	10.0		15.62	
TCPSSL/HCPSSL	5.83	1.69	6.60	3.61	3.23	11.76	13.33					1.52			4.53	
SRA	1.94	1.69	3.77		3.23	17.65		9.09	12.50			6.06			2.92	
Media	3.40	0.85	3.77	1.20		5.88	20.0	9.09				1.52			2.77	
MAS	2.43	0.85	6.60		3.23							1.52			2.19	
Productivity Services	2.43	0.85	1.89	2.41	3.23	5.88	6.67					3.03			2.19	
Terrain	0.49			1.20				9.09				9.09			1.31	
Meetings	1.94	1.69	0.94	2.41								0.00			1.31	
BSES	1.94			2.41								3.03			1.17	
Industry representative	0.49	1.69	0.94		3.23				12.50						0.88	
Family/Friend	0.97	0.85	1.89												0.73	
Grant requirement	0.97		0.94	1.20											0.58	
DPI				1.20								4.55			0.58	
Chemcert			2.83	1.20									70.00		0.58	

Information source	Workshops and training programs															Other* N=66	Not Specified N=10	Total N=685
	Percent of participation (%)																	
	Nutrient Management N=206	Smart cane BMP N=118	Aus Chem N=106	IWM N=83	Drainage Sediment Control N=31	Soil Health N=17	Field Days Grower Walk	Precision Ag N=11	Climate Outlook Tools N=8	GPS Basic N=7	WPH&S N=7							
Not specified	10.68	11.86	16.98	14.46	3.23	17.65	40.00					14.29	22.73				14.45	
Other**	3.40	3.39	1.89		3.23				12.50				13.64				3.50	
Total (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	

*Category 'Other' workshops and training programs include Digging Deeper (Terrain/ David Hardwick), Project Catalyst Growers Forum, Regen Ag, Diploma of Agriculture, Land management Terrain, Water Use Management, Spray Technology (WTSIP), Certificates, Commercial Applicators Course, ACDC/ACDC Spray licence, Farm Business, Harvesting best practice, Productivity meeting, QCane Select, Rat baiting, Terrain Bio Fertiliser workshop, Reef Rescue/Reef Programme, Compass

**Category 'Other ' information sources include Powertrain, Numtech, ACFA, TGT,FS, BD FNQ, John Barbetti, FC facilitator, QCGO, John Deere, MSF, Project catalyst, John Barbetti, QCGO, Smartcane

3.2.6 The most useful workshops or training programs and reasons they were useful

Cane growers were asked what was the most useful of these workshops or training programs and why. The growers' comments are shown in Table 27.

Table 27: Cane growers' comments about the most useful workshops and training programs

<i>Workshops/Training programs</i>	<i>Comments</i>
Nutrient management (WTSIP)	<ul style="list-style-type: none"> • Most important issue for industry • Up front calculations • Productivity, compliance, profitability • Proven ideas cost effective process • Because its benefits go industry wide • Fertiliser application rates rectified • Read soil samples • Help with N calculation for fertilising • Deadly related to farm • It gave an idea of the optimum level of fertiliser for the optimum cane growth • Because it was a way of learning new practices • Ability to interpret soil samples and calibrate fertiliser usage • Useful on land • Relevance to farming • Help to choose fertiliser (I don't have to rely on fertiliser resellers' recommendation) • Nutrient learning • New ideas • Improved knowledge of inputs • Required for Reef Rescue Grant licence to farm • Interesting content, made me a lot more aware of right fertiliser rates • Use constantly • Otherwise will get in trouble with the government • Proper calculations for fertilisers • Very useful- I can comply better than before • Good understanding of fertiliser requirement • Practical calculation of fertiliser application rates • Knowing how to get the best out of different soils • Practical calls to help growing cane • Because of knowledge transfer • Used now for years as plant of my farm practices • Immediately practicable especially for someone new to industry • Better nutrient understanding • Practical • By a country grant programme

<i>Workshops/Training programs</i>	<i>Comments</i>
	<ul style="list-style-type: none"> • Informative and managerial skills • Don't need to relay on agronomist • Covered the most area • General help covers most general decision making • Understand nutrient management a bit better • Practical calculations of fertiliser application rates • Gained up to date information and qualification • They help to improve my farming practices • Max sustainability, ability to provide agricultural advice
Smartcane BMP	<ul style="list-style-type: none"> • Highlighted value of record keeping • Canegrowers compliance • Helps with compliance
Integrated Weed Management (WTSIP)	<ul style="list-style-type: none"> • Knowledge of weeds • Because I found out what poison to use, when and what products were compatible • Rates • Better weed management; keep up to date with chemicals/rates • Explains about poisons and especially the spray-jell technology and timing for weed control • New products • Kept me informed on the latest happenings in the industry • Because of knowledge transfer • Gained up to date information and qualification • They help to improve my farming practices
AusChem	<ul style="list-style-type: none"> • The constant up to date information is useful • Have an insight into what was expected • Nozzle selection/spay/equipment • Good practical knowledge on nozzles and application • Learn about chemical action on weeds • Control the cost of spraying, not wasting poisons • 5 years accreditation • Very useful- I can comply better than before • Kept me informed on the latest happenings in the industry • Legally allowed to spray • Learn about control of sprays • More accurate spraying methods • Improved spraying efficiency • Because of knowledge transfer • They help to improve my farming practices • Chemical usage - gave ideas about better and cheaper tactics for spraying • Registration to buy chemicals

<i>Workshops/Training programs</i>	<i>Comments</i>
Drainage and Sediment Control (WTSIP/BMP)	<ul style="list-style-type: none"> • Cost effective methods and environment protection
Smartcane BMP	<ul style="list-style-type: none"> • Record keeping and government compliance • Extensive plus accreditation for production • It covers a lot of everything • Covers all aspects • Very useful- I can comply better than before • Overall approach to farm management • Education • Clearer direction in assisting me to change my farming practices
Precision Agriculture (WTSIP)	<ul style="list-style-type: none"> • Insight into productivity elevation. Do about four courses per year • Reduce costs • Promote thinking especially soil health, farming system
ACDC spray licence	<ul style="list-style-type: none"> • Good practical demonstration interesting concepts
Business Management	<ul style="list-style-type: none"> • No comments
Digging Deeper (Terrain/David Hardwick)	<ul style="list-style-type: none"> • No comments
Wetlands Sediment Trap Design (QDAF)	<ul style="list-style-type: none"> • Getting together with likeminded people and discuss common issues and constantly learning new things
Field Day / Grower walk	<ul style="list-style-type: none"> • Kept me informed on the latest happenings in the industry
Project Catalyst	<ul style="list-style-type: none"> • Being able to talk to other growers with similar goals
GPS Basics (WTSIP/TCPSL)	<ul style="list-style-type: none"> • No comments
Land Management Terrain	<ul style="list-style-type: none"> • No comments
Productivity Services info meetings	<ul style="list-style-type: none"> • Many relevant topics

The cane growers' other comments were:

- 'The programs are based on information acquired up to 30 years ago and have not been updated accordingly. Most growers have completed and tried these practices more than 5 years ago'
- 'Because of off-farm working I don't get to workshops'
- 'There were other interesting courses advertised that we could not get to due to work commitments'
- 'I read magazines a lot for information'

3.2.7 What could be done to make grants, training programs, workshops and/or extension activities work better for cane growers and graziers to help them meet their personal goals

Cane growers were asked 'what could be done to make grants, training programs, workshops and/or extension activities work better for cane growers to help them meet their personal goals'?

Growers' positive and negative comments are shown in Table 28.

Table 28: Cane growers' positive and negative comments about making grants, training programs, workshops and/or extension activities better to help them meet their personal goals

Positive comments

'Happy now'

'Currently appropriate'

'Overall they are fine the way they are'

'Nothing'

'Currently well delivered'

'Happy with training and extension workshop that we have'

'Happy with current formats'

'Reef Rescue - good program and good outcome'

'Happy with Reef Rescue'

'Reef Rescue concept is good - reef in everyone responsibility and it is fair to get some tax payer support'

'Happy - Reef Rescue is a good process'

'Reef Rescue is a reasonable'

'Reef Rescue is a good program and effective'

'Reef Rescue was the last program ever'

'Reef Rescue was very good; happy with 50/50 split'

'Reef Rescue 50/50 split a good process'

'Grants are a good support mechanism: it helps farmers up-grade their farming practices'

'Ok at the moment'

'Fairly happy with current methods'

'Happy with current system - would like to be able to still access Reef Rescue'

'Satisfied with current provisions'

'Reef Rescue not a bad program: like 50/50 contribution'

'Reef Rescue process is consistent with how farmers are trying to get steadily better'

'Reef Rescue is pretty good - need a local research station'

'Fairly satisfied with current systems'

'All good'

'Not much'

Negative comments

'More knowledgeable instructors'

'Do it instead of talking about it'

'Have told governments how to do it better but they don't listen'
'Fairer price for product to enable farmers to do things; reward for farmer doing the right things, rather than rewarding the high pollutions'
'Poorly targeted - often outcomes are already achieved'
'Set realistic goals (e.g. nitrogen rates etc.)'
'Government brings in compliance so Government should assist more with helping farmers comply'
'Not happy with revise tender grant. Small landholder has no chance of a successful application. Time constraints on completing program need to be more flexible. Also training and courses need more opportunity as to fit in with people'
'Lots of money wasted by governments, farmers still doing what always done'
'Cane payment formula 100 years old, needs orderly marketing to cane counts'
'More involvement with people at coal-face of farming when developing grants projects: de-politicise the practice change recommendation'
'Don't get involved'
'Not really interested in training/workshops'
'Government being too pushy- threatening with audits is wrong'
'Government doesn't want to help the people with financial assistance who have done the right thing for years'

Other growers' comments and suggestions about grants, training programs, workshops and/or extension activities are shown in Table 29.

Table 29: Cane growers' other comments and suggestions

'Make the application process for grants easier and simpler'
'Less paperwork'
'More available'
'Training programs are good. Grants should be run fairly for big and small growers'
'Outcomes for reef would be better if grants were less prescriptive'
'Reward people who are doing the right things, fewer strings attached to grants'
'Grants to quality research before material grants to production'
'Tender process is too complicated'
'Cheaper'
'Better distributions of funds. Should be based on per Ha figures. \$20/Ha for a property'
'Make them less complicated, more transparent, and more willing to help farmers'
'Simplify application process for grants, workshops - off season'
'Less difficulty in accessing programs may be bonus for successful outcomes'
'More funding available'
'Less paperwork, RR is a good option'
'Application process is arduous, otherwise happy with current system'
'No farmer contribution, simplify application process (e.g. A 'reverse auction)'
'Make less theoretical and simpler to apply; better publicity and longer lead-time to apply for grants'
'Clearer understanding when it comes to grant processes'
'Easier application process'

'Easier to understand'
'Easier to be accepted in grants'
'Maintain hard copy government application process; one on one farm specific extension'
'Take out some application'
'Better workshops/descriptions of grant programs to help with the decision whether to apply'
'Needs to be more training on writing up proposals for grants. Application process needs to be more grower friendly'
'Group trainings, exploration of why some grants successful and some not'
'Smaller group discussions - local grower clusters include harvesting contractors'
'Smaller grower groups- comfortable groups so they can open up'
'Small focus groups'
'Practical small group meetings/workshops'
'Small groups - better help from instructors'
'Small groups - working focus groups'
'Smaller groups - factual based area specific evidence'
'One-on-one rather than group training'
'One on one extension specific to actual property'
'Training and workshops'
'Help personal + environmental + social'
'More personal'
'More demonstration'
'Practical demonstration, field trials'
'More notice'
'Concise accurate information'
'More information shared about programs'
'More detailed content'
'Lots of reminders, by text (not email); lots of notice in advance'
'Better advertising, better pre-information'
'Trail/demo, bus tours'
'Field trips'
'Simplify presentation/More emphasis on practical production'
'Diverse hands on practical workshops'
'Most training is learner level, I need more advanced stuff'
'Presenter must be at a level the audience understand'
'Focused on profitability for grower and environmental outcomes'
'Workshops/practical or new information'
'Refresher workshop'
'Follow up workshops - refresher information'
'More regular, refresher courses'
'Open more to earlier adopters'
'Help consolidate knowledge'
'In field training'
'Workshop style programs best'
'More practical demonstration'
'More information on new regulations'

'Provide more'
'More info and education'
'More grants for machinery and technology'
'More practical presentation - layman's terms'
'Detailed information (what on agenda)'
'Timing'
'Having at a better time of year Xmas – Easter'
'Got to be relevant, timing (of year)'
'Extended time period for program if change is good or bad. Insurance again risk of failure if practice unsuccessful'
'Less time consuming, make more farmer friendly'
'Timing - not always at week days'
'Find more hours in a day'
'Have flexible hours'
'More time flexibility'
'Offer evening sessions or late week sessions'
'Shorten growing season - always finish mid November'
'Timing (e.g. wet season)'
'Wider time limits on workshop availability'
'Schedule for early in year when not as busy'
'Better timing of application process allow more time'
'Running later the day after work'
'Workshop training program work well (Jan to May) good time'
'Timing - advanced warning 1 month'
'Have workshops at a better time; make grants more accessible for smaller growers'
'Find mate suit us better to personal goal'
'Ask the growers what they would like - keeping modern ways of farming more relevant'
'Relevant to sugar industry (industry specific)'
'Relevant to farm practices'
'Tailoring for each individual farm'
'More targeted to sub-districts'
'Content, more tailored for Tablelands'
'Individual - assessment on what is required'
'Make more relevant'
'Winding down on farming'
'Backing of due to age - not that relevant'
'I am reliant on the share farmer to undertake these activities'
'Small farm - no need'
'Not at this time of my life'
'Help from extension officers'
'Not looking for learning at this stage in life'
'Smaller growers in disadvantage'
'Extension on consultancy form (on phone, onsite)'
'Assist young people to enter and drive industry'
'Farmers get possible price for cane'

'Police the programs, make sure money is used for the right reasons'
'Think differently on how to get complete change farm group grant applications'
'Isolate farm as independent financial entity for grant applications'
'Not steam land or accessible to older farmers'
'Tender programs are better than Reef Rescue'
'Reef Rescue was a good process but did not target new growers'
'Like to see Reef Rescue continue'
'Reef Rescue was a really good program Reef Rescue should be 70/30 government/grower'
'Reef Rescue is good. Ratio should be 75 Government/25 grower'
'Like Reef Rescue and training but timing of training needs to be scheduled after hours'
'Reef Rescue not bad but needs better actioning. There is some fraudulence Continue Reef Rescue process. No on-selling gear within 5 years'
'Reef Rescue - get half the money helps you contribute and achieve goals. Grants have helped a lot. Money helps to try and change. Need \$ to support innovation and progress ideas to support industry'
'Do away with Reef Trust auctions'
'Process led to inflated prices for equipment weighted towards bigger farmers: better way to go would be to offer better investments allowances'
'Make grants more suitable for smaller growers - growers who have transitioned' to new structures earlier are being left out'
'All growers should be accessible - especially little growers'
'More relevant to small farmers'
'Make it attractive to smaller growers'
'Grants to date favour large farmers - need to consider small farmers'
'All growers to be equal just not the big growers'
'Not interested'
'Often wider benefit right from doing the training. Has to be right person to learn from'
'More face to face discussions so people understand and see my passion for farming'
'Better R&D presenters'
'Get industry and governments more involved'
'Flat out getting time to go fishing, let done courses'
'Let Mossman Ag know dates etc.'
'Early transition to new farming system made it more difficult to secure funds to further improve farming system'
'Better relationship between local prod service and government grants'
'Funding directed towards people who want to make change assessing those who want to leave industry (e.g. exit packages)'
'Financing changed farming system for farmer close to retirement. How?'

3.2.8 Extension support or training that cane growers and graziers would like to have in the future to help them make farm improvements

Cane growers were asked “what extension support or training would cane growers like in the future to help you make farm improvements?”

Growers’ positive and negative comments are shown below (Table 30).

Table 30: Cane growers’ comments about extension support and training

Positive comments

‘All good’

‘I am happy with what is available’

‘Sufficient’

‘Nothing’

‘Currently ok’

‘Comfortable with current arrangements’

‘Happy with current position’

‘The programs are adequate. Offering help with these programs and grants would be very useful’

‘I am happy with what is available now’

‘Currently reasonable’

‘Currently pretty good’

‘Ok at the moment’

‘Current system is ok but not as good as old BSES when extension officer had a lot of local experience’

‘Good support at present’

‘Not much - under control’

‘Good - need more RSD work - pre-emerged herbicides’

‘Maintain what is at present - but include newer practices’

‘Current programmes are pretty good’

‘Currently reasonable’

‘Satisfied with current system. A new system needs good extension support’

‘Continue courses and field trips’

‘Varieties are horrendous; training is good. Not do too much more. Re-install BSES type extension services’

Negative comments

‘No more - had enough’

‘Need people who have experience (not failed farmers or first graduates)’

‘Not interested’

‘Research and advisory are disconnected. Support re-installing BSES model of research and extension’

Cane growers' other comments and suggestions about extension support or training are shown in Table 31 31.

Table 31: Cane growers other comments and suggestions about extension support and training

<i>'Soil health'</i>
<i>'Soil health and micro nutrient management'</i>
<i>'Explaining how to interpret detailed soil analysis from EM survey'</i>
<i>'Soil health/soil biology'</i>
<i>'Soil courses'</i>
<i>'Advice re Soil samples'</i>
<i>'Soil biology'</i>
<i>'More to do with soil health'</i>
<i>'Soil nutrition'</i>
<i>'Improve understanding of soil'</i>
<i>'Advanced nutrient management - soil quality'</i>
<i>'Improved coordination of known data (e.g. 6 Easy Steps match to variation - research, learning and soil type'</i>
<i>'Landcare issues'</i>
<i>'Agronomy'</i>
<i>'Better cane variety and information on varieties and agronomy support to address decreased productivity'</i>
<i>'Info overload, more training for agronomists'</i>
<i>'Good agronomist is needed in the Herbert'</i>
<i>'Plant root health'</i>
<i>'Record keeping'</i>
<i>'Real time/Record keeper/Spray records'</i>
<i>'Record keeping and compliance, refresher courses'</i>
<i>'Electronic record keeping'</i>
<i>'Training in keeping records'</i>
<i>'Easier record keeping (i.e. app for mobile phone)'</i>
<i>'Training with GPS technology for controlled traffic'</i>
<i>'Advanced use of GPS for precision Act'</i>
<i>'Training on GPS systems, setup, and how to use'</i>
<i>'GPS and its applications'</i>
<i>'More extension officers on ground'</i>
<i>'Continuing use of extension officers'</i>
<i>'Extension useful needs support'</i>
<i>'Extension officers important for keeping knowledge up to date: great communication device is the extension officer for farmer to farmer'</i>
<i>'One on one extension'</i>
<i>'More extension officers (e.g. Deb Telford)'</i>
<i>'Extension is extremely important, DPI has dropped off, BSEs (now SRA) has overpaid officers extension'</i>
<i>'Farm visits to see how others do it'</i>
<i>'Extension and refresher courses incorporating new ideas (e.g. field tours)'</i>

'Extension needs to focus on developing business skills in the farmer so were allow farmer to understand why it is good business to be sustainable which include environmental sustainability'

'Extension, something old BSES programmes'

'General extension officers to provide whole range of information (e.g. Michael Porter from MSF)'

'General extension officers with wide range of information'

'Re-install old BSES extension services'

'One on one agronomic and extension support'

'I am an extension provider'

'Extension officers to calibrate fertiliser and spray equipment'

'Would like to have the old BSES extension services'

'Development pathways for extension officers'

'One on one extension support'

'Like extension to be more hands on. Extension is valuable'

'Back to the old BSES style one on one extension more information workshops'

'Assistance from grants officers'

'Drainage services; water quality monitoring'

'Drainage workshop'

'Assistance with drainage issues'

'Sub-surface drainage and constructed drainage design'

'One to one'

'Good mixture of group and one on one and some financial education not advising'

'Face to face training'

'On farm visit'

'TCPSL - more visits'

'Workshops small to medium, one on one'

'Face to face is best'

'One on one, farm specific, advice recommendations'

'One on one farm specific advice'

'Private'

'Computer training'

'New technology/More advanced nutrient management/Mapping soil types/ yields'

'Keep up with new technical knowledge'

'More info on new technology and herbicides'

'Keep in touch with advanced technologies'

'Info on latest technology and products'

'New technology/research/products - fertiliser and chemicals'

'New technology training, drones to identify weed location'

'Requires an experimental farm (not just variation) for local testing different practices including innovations'

'Keep pace with technology'

'Demonstration/validation of new practices (with scientific rigour - that covers on agronomy, economics, environmental etc.)'

'More advanced and up to date on fertiliser and chemicals'

'More advice on new fertilisers'

'More advanced up to date chemical information'

'More advanced knowledge on cane farming practices, cultivation, fertiliser, planting'

'Refresher each year on up to date chemicals and use methods'

'Up to date information on chemical alternatives and usage'

'More information on new environmentally friendly chemicals'

'Up to date refreshers on chemicals including new products'

'Bio fertiliser options'

'Alternate farming methods (e.g. chemical, Fertiliser etc.)'

'Advanced chemical advice - up to date'

'Nutrients - area specific'

'Variety, nutrient and technical support'

'Nutrient course - for small crops (diversity crops)'

'Courses in nutrition, weed control, business management'

'Collate nutrient data to future fine tunes inputs'

'More advanced weed recognition'

'Pest management, weeds, pesticides'

'Major problem in feral pigs- this requires funding a head of anything else'

'Information on electric fencing for feral pigs'

'More advanced harvesting practices'

'Safety on farm and harvesting'

'More advanced harvesting techniques'

'Different areas should have different programs suited towards them'

'Case by case basis, each farm is different'

'More replicated trials on individual farms in sub-districts'

'Variety developments'

'As previous ventures worked fine'

'More guidance on things that have worked'

'We learn by farmers who try everything'

'Learn what is working and share that knowledge'

'Similar to what has happened'

'Cross population of ideas - field days etc. one on one'

'Monitoring farm improvements and quantifying'

'A training program where growers can measure their own off-farm run-off'

'After work meeting so we don't lose production'

'Something that is effective and not time consuming'

'After hours courses'

'Trials, R&D'

'More R&D & better communication'

'Controlled release fertiliser more research and information'

'Everything needs research and development'

'Have research on farms and demonstration'

'More people in productivity board to see farmers and have a chair'

'Prod Board have good potential so could be subsidised for innovative programme'

'Nice to know more about water quality but at a language suitable for farmers'

'Revegetation'

'WHS'

'Visual training (e.g. tours) are the most efficient'
'Encouragement of best practices for all farmers'
'More advanced precision agriculture'
'Smartcane BMP/6 Easy Steps'
'RSD testing'
'WHS on farm/Electrical safety'
'Flood mitigation'
'Productivity training, varieties, pest management'
'NMP'
'HPSL/SRA'
'Better pesticide management'
'Improved medium term (3-6 months/season) weather forecast'
'Liked old BSES system, would like much of it return'
'More advice on the rigour of cane variety selection'
'Precision Ag/Drainage'
'Precision Ag for John Deere'
'More Reef Rescue programs'
'Reinstate Reef Rescue'
'Any topic would be helpful'
'Training courses 1-2/year'
'Refresher courses to keep up to date'
'Skills improvement (e.g. harvester operators, bin handlers etc.), general trade skills (e.g. machinery, welding)'
'SRA updates, shed meetings - keep aware of latest'
'Education of wider public of the form the farmers are going to minimise off-farm impact'
'Continue - more to do with herbicides'
'Increase in workshops focusing on newer herbicides'
'Continue passing information to growers'
'More publications on trial results from SRA'
'To make money'
'How to make money + keep it (not spend it on other people)'
'More info on varieties'
'I go to all of the meeting and training that is provided'
'Very little'
'No preference'
'Not looking for learning at this stage in life'
'None. I am usually finding out the important information from other growers'
'None of the same'
'Cane farmers have worked this country for many years with lots of success. Now we have the bureaucrats teaching us what to do...a lot better without teach'

3.2.9 Current practices (self-reported behaviour)

Irrigation practices

Cane growers were asked if they were involved in any irrigation practices. One hundred and nine respondents⁴ answered this question. Eighty-three and a half percent of respondents said that they are not involved in any irrigation practices and 16.5% said that they are irrigating their crops. As such, the following analysis of data related to irrigation practices is based on 20 observations.

Growers who irrigate crops were asked how much irrigated water they use per hectare (acre) for their crops each year (see Table 32), how much irrigation water runs off their blocks and which irrigation scheduling tools they are using (Table 33). More than 68% of cane growers said that they use between 0ML and 5ML of irrigated water per hectare per annum, nearly 16% of respondents use 5-10ML, 5% up to 15ML and the rest of cane growers said that it was not applicable or they do not know (Table 32).

Table 32: The amount of irrigated water that cane grower uses per hectare (N = 19)

<i>ML per Ha</i>	<i>Percent of cane growers (%)</i>
0-5ML	68.42%
5-10ML	15.79%
10-15ML	5.26%
N/A	5.26%
Don't know	5.26%

One hundred percent of respondents estimated that run-off from their irrigation is between zero and 25% of all irrigated water used on the block.

Fifteen percent of cane growers are using multiple irrigation scheduling tools and 30% are using a single irrigation scheduling tool (soil moisture probes such as tensiometers & capacitance probes). Forty percent of cane growers are not using any irrigation scheduling tools (see Table 33). Ninety-five percent of participants were planning to use the same irrigation scheduling tools next year.

⁴Those who left this question blank or who crossed it were excluded from the analysis

Table 33: Irrigation scheduling tools used by cane growers (N=20)

<i>Irrigation scheduling tools</i>	<i>Percent of cane growers (%)</i>	<i>ABCD framework</i>
Soil moisture probes such as tensiometers & capacitance probes*	30%	D-C
Mini pans/Soil moisture probes such as tensiometers & capacitance probes**	10%	C
Mini pans/Soil moisture probes such as tensiometers & capacitance probes/ Calculation of daily crop water use, using crop factors, class A pan, or crop model (e. g. WaterSense)	5%	C-B
Other***	15%	D-C
None	40%	D

*'Visually', 'pumping rates per rainfall equipment', 'go by plant, and Enviroscan were also mentioned by growers as irrigation tools

** Test from Productivity Services and recommendations were also mentioned by growers as irrigation tools

***Category 'Other' include calculator built into system, advisor does calculations, Enviroscan/Shovel/Hands & watch the drain

Cane growers were asked how much they agree or disagree with statements related to their current tools for scheduling irrigation (a seven-point Likert scale from strongly disagree = 1 through to strongly agree = 7 was used to assess each statement) (Table 34).

Ninety-two percent of cane growers agreed or strongly agreed that their current system for scheduling irrigation is the best way to maintain good cash-flow and 83% agreed (agreed/strongly agreed) that it is the best way to reduce business risk. Eighty- six percent of participants agreed or strongly agreed that their current system is the best way to meet their own personal goals and 7.1% disagreed with this statement. Eighty - three percent agreed or strongly agreed that it is the most effective way of controlling nutrient loss from their property (16.7% somewhat disagreed with this statement). Eighty-seven percent believe they were not forced to use irrigation scheduling tools (strongly disagreed with this statement) and 12% felt neutral about this statement (Table 34).

Table 34: Attitudes and motivations associated scheduling irrigation (N=12)

	Percent of cane growers (%)							
	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree	Do not know/
The farmers I respect most do this	7.7			30.8	7.7	23.1	15.4	15.4
Most farmers in this region would not have the technical knowledge	9.1	9.1		27.3	9.1	9.1	9.1	27.3
Most farmers in this region would not be able to afford to do this	27.3	18.2		36.4				18.2
I only do it because I am forced to	87.5			12.5				
The people/organisations whose advice I follow most think I should do this	9.1		9.1	18.2		27.3	27.3	9.1
The best way to meet my own personal goals		7.1			7.1	21.4	64.3	
The best way to maintain good cash-flow					8.3	33.3	58.3	
The best way to reduce business risk				8.3	8.3	25.0	58.3	
The least time-consuming (or labour intensive)		16.7	8.3		25.0	16.7	33.3	
The most effective way of controlling nutrient loss from my property			16.7			25.0	58.3	

Cane growers were asked to select whose advice they follow most when scheduling irrigation (Table 35). Industry extension advisors such as SRA [BSES], Production Boards, and Productivity Services group were highly ranked of whose advice cane growers follow most.

Table 35: Rank of importance of whose advice cane growers follow most when scheduling irrigation (N= 20)

	Rank of importance of whose advice cane growers follow most when scheduling irrigation													
	Very important												Very unimportant	
	1	2	3	4	5	6	7	8	9	10	11	12	No rank	
Family who are also cane farmers		1	1		1								1	
Other cane farmers	1	1	2		1								1	
Cane growers (the organisation)		1		1	1									
Regional cane association (e.g. from Kalamia, Invicta, Inkerman, Tully Sugar)														
People from NQ Dry Tropics/Terrain					1									
Private Agronomists				2										
Landcare		1												
Researchers		3		1										
Industry extension advisors (SRA [BSES], Production Boards, Productivity Services group)	8	3	1	1	1									
Other extension officers. From where?														
People from government departments. Which departments?														
Other. Who?*	7	1		1										

*Category 'Other' include 'self taught 50 years experience', 'myself (Ag engineer)', resellers, 'myself based on local knowledge', and 'Inbuilt wardhart electronic'

Calculating fertiliser application rates

Cane growers were asked how they calculate fertiliser application rates. They were allowed to give more than one answer. More than 55% of the participants said that they are using multiple ways to calculate application rates. Sixteen percent indicated that their advisors do it for them and 12% said that they tailor their fertiliser rates to different parts of the property while 11% use industry standard rates for district yield potential and use that amount on all parts of their farm (Table 36).

Table 36: Different ways to calculate fertiliser application rates (N=245)

	<i>Percent of cane growers (%)</i>	<i>ABCD framework</i>
My advisor does this for me*	16.33%	B
I tailor my fertiliser rates to different parts of the property**	12.65%	B
I use industry standard rates for district yield potential, and use that amount on all parts of my farm***	11.02%	C
I use industry standard rates for district yield potential, and use that amount on all parts of my farm/My advisor does this for me/I tailor my fertiliser rates to different parts of the property	11.02%	B
My advisor does this for me/I tailor my fertiliser rates to different parts of the property	10.20%	B
I tailor my fertiliser rates to different parts of the property/6 Easy Steps	10.20%	B
I use industry standard rates for district yield potential, and use that amount on all parts of my farm/My advisor does this for me	9.39%	B
I use industry standard rates for district yield potential, and use that amount on all parts of my farm/I tailor my fertiliser rates to different parts of the property	6.94%	B
I estimate amounts from my farm yield and use that amount on all parts of my farm	5.31%	C
I use more fertiliser on under-performing (low yield) blocks than on other blocks/I tailor my fertiliser rates to different parts of the property	1.63%	C
Other****	5.31%	D-B

*Also mentioned 6 Easy Steps, local agronomist, MAS, Soil tests, a second option from Productivity Services extension officer, experience, farm climate, advisor, more fertiliser on under-performing (low yield) blocks, and tailoring fertiliser rates to different parts of the property

** Also mentioned NMP, pressure for plant, soil tests, and GES

***Also mentioned mill product, 6 Easy Steps, regulator recommendations, and GES

****Category 'Other' include BMP recommendation, historical fertiliser amounts, 'I have arrived at nutrient programme over a period of time by analysis of data (testing) and cropping results. Productivity results ground truth this approach', liquid fertiliser, soil test, soil type, use my historically min rates, sulphate of ammonium, GES, Incitic recommended rotations, estimate amounts from farm yield and soil tests - follow GES, experience, and private agronomist advice

Cane growers were asked how much they agreed or disagreed with statements related to their current system for calculating fertiliser application rates (a seven point Likert scale from strongly disagree = 1 through to strongly agree = 7 was used to assess each statement) (Table 37).

Nearly 80% of respondents indicated that their current system for calculating fertiliser rates is the best way to maintain good cash flow and that it is the most effective way of controlling nutrient loss from their property (agree or strongly agree with those statements). Seventy-eight percent of participants agreed or strongly agreed that it is the best way meet their own personal goals. Seventy-five present agreed or strongly agreed that current system is the best way to reduce business risk.

Nearly 77% believe they were not forced to calculate fertiliser application rates (disagreed or strongly disagreed with this statement) and 5.7% felt they were somehow forced. Twenty-two people made a comment on who/what forcing them to calculate the application rate and indicated that it was State Government, government regulations, EHP, bureaucrats, Reef compliance, computer control equipment, share farmer, compliance and regulations and legislations.

Table 37: Attitudes and motivations associated with calculating fertiliser rates (N varies between 212 and 221)

	Percent of cane growers (%)							
	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree	Do not know/ Not sure
The farmers I respect most do this	3.2	2.3	3.6	13.1	14.5	27.1	18.6	17.6
Most farmers in this region would not have the technical knowledge	24.9	17.4	9.4	16.4	9.4	7.0	2.3	13.1
Most farmers in this region would not be able to afford to do this	45.8	20.6	7.0	9.8	2.8	3.3	.5	10.3
I only do it because I am forced to	66.5	10.4	5.7	7.5	.5	1.9	3.8	3.8
The people/organisations whose advice I follow most think I should do this	3.7	3.2	1.4	12.8	7.3	27.1	40.4	4.1
The best way to meet my own personal goals		.5	1.4	5.5	11.5	29.0	49.3	2.8
The best way to maintain good cash-flow	.5	.5	.5	6.8	11.4	33.8	45.7	.9
The best way to reduce business risk	.5	.5		7.3	14.2	31.7	43.1	2.8
The least time-consuming (or labour intensive)	1.4	2.8	7.8	17.4	10.1	25.7	33.9	.9
The most effective way of controlling nutrient loss from my property	.9	.9	1.4	5.0	9.2	29.8	50.0	2.8

Cane growers were asked to tell us whose advice they follow most when calculating fertiliser application rates (Table 38). Industry extension advisors and private agronomist were highly ranked of whose advice cane growers follow most.

Table 38: Rank of importance of whose advice cane growers follow most when calculating fertiliser application rate (N=181)

	Rank of importance of whose advice cane growers follow most when Calculating fertiliser application rate													
	Very important												Very unimportant	
	1	2	3	4	5	6	7	8	9	10	11	12	No rank	
Family who are also cane farmers	13	20	13	6	5	1		1					4	
Other cane farmers	6	20	35	12	11	1	1			1			6	
Cane growers (the organisation)	5	9	14	19	13		1		1				3	
Regional cane association (e.g. from Kalamia, Invicta, Inkerman, Tully Sugar)			2			1	1	1	1	1			1	
People from NQ Dry Tropics/ Terrain		2	3	3	2		1		1	1	1			
Private Agronomists	38	29	19	4	7	2							7	
Landcare	1	1	1		3	1		1		2				
Researchers	18	22	17	13	9		1		1				3	
Industry extension advisors (SRA [BSES], Production Boards, Productivity Services group)	11	43	11	7	2			1					7	
Other extension officers. From where?*	8	15	8	8	8		1			1	3		6	
People from government departments. Which departments?***		2	6	3	4	1		1	1	2	1	1	1	
Other. Who?***	31	23	6	4	1							1	8	

*Other extension officers were from Smartcane BMP, MSF Sugar, DAFF, TCPSL, G Fertiliser, SLA, Babinda & Innisfail Productivity Board, & fertiliser suppliers

**Government departments were DPI, DSITI, DAFF, SRA, & DERM

***Category 'Other' include Agribusiness, in-house agronomist, agronomist from supplier, AS per soil analysis from HCPSC - fertiliser company, BMP, experience & knowledge, fertiliser industry representatives, fertiliser reseller agronomist, myself, fertiliser supplier, financial & environmental constraints, MAS, myself – qualified soil analyst/certified practising agriculture, family, soil test result & samples, self education, share farmer, Smartcane BMP

Handling run-off practices

Similar to irrigation and fertiliser rate application, more than half of the cane grower participants (>60%) are using multiple ways to handle run-off. Nearly 43% had recycle pits and sediment traps to recycle the water. Fourteen percent of participants have grassed headlands and use trash blankets and 36% indicated that they do not capture run-off. Nearly every respondent was planning to use his or her current approaches next year (Table 39).

Table 39: Practices for handling run-off from rainfall and irrigation (N=243)

	Percent of cane growers (%)	ABCD framework
I have recycle pits/sediment traps*	42.39%	C
Grassed headlands/Trash blanket**	7.41%	C-B
Grassed headlands***	6.58%	D-B
Grassed drains/Underground drainage	2.06%	B
I have recycle pits/sediment traps and have adequate pumping capacity to recycle the water	0.41%	B
I do not capture run-off	36.21%	D
Other****	4.94%	C-B

*Also mentioned buffer zones, grassed headlands and drains, riparian buffer, trash blanket, natural lagoon or site that filter run-off, silt traps on drains, contouring, grass waterways, good farm layout, early fertilising, minimal tillage, spoon drains, riparian vegetation, clean drains, good fallow cover, graded headlands, contour banks, some contoured rows, grassed creeks, grassed slopes, levee banks, paddock layout, laser levelling, bank stabilisation through tree planting, no tillage in ratoons, zonal tillage, flood gates, rock pitching, rock walls, planting rows across the flow, green harvest, rush planting in wetlands, planted trees, retaining walls, silt, Integrated surface drainage, legume fallow, wetland.

**Also mentioned bank stabilisation with rock, mowed drains, grassed drains and waterways, riparian vegetation, minimum tillage, green harvest, vegetated creeks, spoon drains, and trees

***Also mentioned clean drains, re-use the cleared sediment, grassed drains and waterways, rocks, spoon drains, GCTB, riparian vegetation, contours, and minimum tillage

****Category 'Other' include engineered wetlands, rock walls, planted trees, natural gully, natural sediment trap, constructed drainage network, grass mapped paddocks, 10m wide grassed headland, 40m of vegetation to watercourse, and water detained by small pipes.

Cane growers were asked how much they agree or disagree with statements related to their current system for handling run-off (a seven – point Likert scale from strongly disagree = 1 through to strongly agree = 7 was used to assess each statement) (Table 40).

Table 40: Attitudes and motivations associated with handling run-off from rainfall and irrigation (N varies from 184 to 248)

	Percent of cane growers (%)							
	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree	Do not know/ Not sure
The farmers I respect most do this	2.6	1.6	1.6	14.1	10.9	31.3	24.5	13.5
Most farmers in this region would not have the technical knowledge	34.9	19.3	7.8	16.1	5.7	3.6	1.6	10.9
Most farmers in this region would not be able to afford to do this	31.3	18.2	9.9	13.5	7.8	4.2	5.2	9.9
I only do it because I am forced to	70.7	10.9	6.0	1.1	1.6	1.1	.5	8.2
The people/organisations whose advice I follow most think I should do this	6.9	2.6	1.1	10.1	9.5	28.6	31.2	10.1
The best way to meet my own personal goals	.5	.5	1.1	3.7	8.4	33.2	48.9	3.7
The best way to maintain good cash-flow	1.1	1.1		12.1	10.0	29.5	40.5	5.8
The best way to reduce business risk	.5	2.6		10.5	9.9	31.9	40.8	3.7
The least time-consuming (or labour intensive)	3.1	4.2	4.2	11.0	9.9	26.7	37.7	3.1
The most effective way of controlling nutrient loss from my property		1.6	1.1	3.2	8.5	30.9	52.1	2.7

Eighty-three percent of cane growers agreed or strongly agreed that their current practices for handling run-off is the most effective way of controlling nutrient loss from the property and 82% agreed or strongly agreed that it is best way to meet their own personal goals. Nearly 73% agreed or strongly agreed that it is the best way to reduce business risk and 70% indicated (agreed/strongly agreed) that their current practices are the best way to maintain good cash flow. Fifty-four percent of cane growers believed (disagreed or strongly disagreed with this statement) that most farmers in the Wet Tropics region have enough technical knowledge to deal with run-off from rainfall and irrigation and 82% indicated (disagreed or strongly disagreed with this statement) that they were not forced to do it. Twelve people made a comment on

who/what forcing them to handle run-off and indicated that it was Government, government regulations and legislations, Reef regulations, and 'mother nature'.

Cane growers were asked to tell us whose advice they follow most when it comes to handling run-off from rainfall and irrigation (Table 41). Industry extension advisors and family who are also cane farmers were highly ranked for whose advice cane growers follow most.

Table 41: Rank of importance of whose advice cane growers follow most when handling run-off (N= 120)

	Rank of importance of whose advice cane growers follow most when Handling run-off													Very unimportant
	Very important	1	2	3	4	5	6	7	8	9	10	11	12		No rank
Family who are also cane farmers	20	21	5	7	6			1						5
Other cane farmers	4	24	17	8	11	1	1		1					5
Cane growers (the organisation)	14	19	17	10	5	2		1	1					4
Regional cane association (e.g. from Kalamia, Invicta, Inkerman, Tully Sugar)			1			1	2		1					
People from NQ Dry Tropics/ Terrain	5	9	10	5	3							1		3
Private Agronomists	1	4	2	2	5				1					2
Landcare	13	6	7	12	6						2	1		2
Researchers	10	15	9	7	11		1	1						2
Industry extension advisors (SRA [BSES], Production Boards, Productivity Services group)	70	24	13	3		1				1				8
Other extension officers. From where?*	4	5	9	2	5	1		2				1		1
People from government departments. Which departments?***		2	5	5	4					2	1	1		3
Other. Who?***	39	4	3	3	1					1		1		8

*Other extension officers from DAFF, TPCSL, MAS Mossman, J.S. Smith, MSF Sugar Mill, Canegrowers, & SRA

**People from government departments from DERM, DNRM, EMP, DPI, DAFF, Terrain, & TMR

***Category 'Other' include private advice, Drainage Board, family who are not cane farmers, Terrain layout, operators who have experience in land conservation, myself, literature from DPI, self education, drainage system designed by P. Jackson FCB, personal passion, family – environmental engineer, son is a civic engineer, Farm tour – canegrowers, ourselves - we saw a benefit, contractors, grader driver, Murray Riversdale Water Board (state Government - continuing same ideas) 15 years ago, Cairns Regional Council, Natural floodplain - no options, Drainage training course also use our experience, Jeff Benjamin - water hydrologist/engineer

3.2.10 Other innovative practices to reduce nitrogen and/or run-off

Cane growers were asked if they use any other innovative practices to reduce nitrogen and/or run-off. Sixty-three percent of cane growers indicated that they do use other innovative practices. Some of other innovative practices mentioned by growers are listed in Table 42 below.

Table 42: Practices listed by the respondents as innovative

Practices
<i>'Using mill mud on late cut cane for slow N release'</i>
<i>'Timing of application and use of drainage to dry out paddocks'</i>
<i>'Legume crops in fallow'</i>
<i>'Stool spitter planting legumes'</i>
<i>'Trash to make earth walls in gullies and washouts'</i>
<i>'Use humate with the nitrogen application'</i>
<i>'Green trash blanket/Stool splitting for application/Spray out fallow/Legume cover crop'</i>
<i>'Irrigate in fertiliser with travelling irrigator'</i>
<i>'Zero tillage/Legume fallow/Trash blanket'</i>
<i>'Slow release fertiliser (entec) or Nitro'</i>
<i>'Laser levelling/Traffic control/New probes'</i>
<i>'I place my fertiliser under the trash in the ground beside the stool 2 row at a time 4 weel that carry the 4 tonnes box the top where the fertiliser is put'</i>
<i>'In bananas we use enhanced efficiency fertiliser and humates with our nitrogen'</i>
<i>'Green cane trash blanket/All fertiliser applied sub-surface'</i>
<i>'Mill mud on all ratoons/Trailing enhanced efficiency fertiliser'</i>
<i>'Adding humates/Split application of fertiliser and liquid fertiliser'</i>
<i>'Liming and mill ash - having all nutrient balanced mean less N is possible'</i>
<i>'Minimum tillage/Reduced inorganic N application through use of mill mud/Legume fallow'</i>
<i>'Variable rate fertiliser box'</i>
<i>'Stool splitting - underground placement of nitrogen'</i>
<i>'Laser levelling'</i>
<i>'Ash/Fallow in soybean'</i>
<i>'Minimal or zero fertiliser in hollow areas/Spray out fallow'</i>
<i>'Mounding/EEF's'</i>
<i>'Variable rate controller/Legumes/Mill mud/Crop age/Harvest time'</i>
<i>'Good cover crops/Diversion drains for water control'</i>
<i>'I use pelletised pouching manure as fertiliser in the cane with a N-content of 3.5% that is the best I can do'</i>
<i>'Zonal mill mud application'</i>
<i>'Uniform planting'</i>
<i>'Using some mill by-products'</i>
<i>'Minimum tillage/Plant with zero fertiliser'</i>
<i>'Humic acid and trace elements, trap N'</i>
<i>'Trials with EEF, liquid fertiliser, low herbicides'</i>
<i>'Incorporating mill mud/ash, re-cleaning soil from headlands and drains'</i>
<i>'Grass seeding sediment pit'</i>
<i>'Drained sub-basin'</i>
<i>'GPS rate control on fertiliser application'</i>
<i>'Tried control release fertiliser (EEF)/Variable rate fertiliser box (manage areas differently)/Would like to load at green siller'</i>
<i>'Split application with overhead irrigation'</i>

Practices
'Use soybean fallow to reduce N in plant; Maintain trash blanket on fallow and ratoon crops'
'Subsurface fertiliser, GCTB, mound planting, laser levelling'
'Bio fertiliser'
'Trials with bio fertiliser, potassium'
'Minimum tillage/cultivation'
'Use t-tape for irrigation'
'Pastures and sediment traps, GCTB'
'BMP'
'Refer to soil samples and utilise sub-surface when applying nitrogen'
'Grass headlands, silt traps, rock stabilisation'

3.2.11 Land managers' perceptions of top causes and pressures on water quality

Land managers were asked about their perceptions of nutrient loss from their property and what they think about water quality in local streams, rivers and waterways (Table 43).

Forty-two percent of cane growers said that they somewhat agree, agree or strongly agree that nutrient losses from their properties are having no impact on water quality in local streams, rivers and waterways, indicating that they do not believe that the losses from their properties are impacting water quality locally. By contrast 30% cane growers somewhat to strongly disagree with the statement indicating that at least one third of respondents believe that their activities are somehow negatively affecting the water quality of local streams, rivers and waterways. Fifteen percent of respondents remain neutral (Table 43

Table 44).

Table 43: Land managers' perceptions of water quality in local streams, rivers, and waterways (N=246)

<i>Nutrient loss has no impact on WQ locally</i>	<i>Percent of cane growers (%)</i>
Strongly agree	18.7%
Agree	15.0%
Somewhat agree	8.1%
Neutral	15.0%
Somewhat disagree	12.6%
Disagree	8.9%
Strongly disagree	8.5%
Do not know/Not sure	13.0%

When land managers were asked about the top causes of poor water quality in their local streams, rivers and waterways (Table 44), 3.7% of cane growers cited that there was no issue with water quality. Cane growers that thought there was poor water quality cited the top causes as feral pigs in national parks and rainforest (16.5%), soil run-off and erosion (11.9%), extreme weather events such as floods and cyclones (11%), and sediment and nutrient run-off (10%). As the second top cause, they cited run-off from urban & commercial areas (16.9%), poor farming practices and other farmers (16.2%), feral pigs in national parks & rainforest (11.8%) and sediment, nutrient and chemical run-off (7.35%). Other noteworthy causes include accidental spills, illegal dumping, mill closures, lack of flow and stagnant water and run-off from steep terrain.

Table 44: Land managers' perceptions of the top causes of poor water quality locally

<i>The top causes of poor water quality in local streams, rivers, and waterways</i>	<i>Percent of cane growers (%)</i>	
	<i>Top cause 1 N=218</i>	<i>Top cause 2 N=136</i>
Feral pigs in national parks & rainforest	16.51%	11.76%
Soil run-off/Erosion	11.93%	5.88%
Floods/Rain events/Cyclones	11.01%	6.62%
Sediments/Nutrients/Chemical run-off	10.09%	7.35%
Run-off from urban & commercial areas	6.42%	16.91%
Poor farming practices/Other farmers	6.42%	16.18%
Banana farms	5.96%	6.62%
National park/Rainforest run-off	4.13%	4.41%
Poor weed control/Weed infestation	4.59%	2.94%
Run-off from other farms	4.59%	2.21%
Poor cleaning of drains & creeks/Blockages	2.29%	2.94%
Local Council and main roads	2.29%	2.21%
Poor ground cover management	1.83%	4.41%
Grazing/Livestock farming	0.92%	1.47%
Government	0.92%	0.74%
No issue with poor water quality	3.67%	1.47%
No idea/Unknown	1.83%	
Other*	4.59%	5.88%
	100%	100%

*Category 'Other' include accidental spills, illegal dumping, mill closures, lack of flow, stagnant water from Swamps, silt in the water, steep terrain, upper catchment, timing on development, and 'weekend warriors in 4-wheel drivers'

The data in Table 44 also indicates that there may be a tendency of blame shifting related to water quality. Two percent of cane grower responses indicate that overgrazing or livestock farming and run-off from grazing are the main reasons for poor water quality in local streams, rivers, and waterways.

Of the 3.7% that cited that there was no issue with water quality, the respondents' comments (Table 45) highlight that this could be because they are at the head of the river system or that the water quality has improved over time.

Table 45: Cane growers and graziers' comments about water quality

'I do not believe the waterways are of poor quality'
'I would like to see proof of the water quality in our local area'
'Local streams are pretty good'

Land managers were asked about their perceptions of the cane growing industry and its role in the declining health of the GBR (Table 46). Forty-nine percent of cane growers said that they are somewhat agree, agree or strongly agree that the cane industry plays almost no role in the declining health of the GBR. By contrast 25% of cane growers somewhat to strongly disagree with the statement while 20% of respondents remain neutral.

Table 46: Land managers' perceptions of cane growing/grazing industry and its role in the declining health of the GBR (N=243)

<i>Cane industry plays almost no role in the declining health of the GBR</i>	<i>Percent of cane growers (%)</i>
Strongly agree	21.4%
Agree	14.8%
Somewhat agree	12.8%
Neutral	20.2%
Somewhat disagree	12.8%
Disagree	9.1%
Strongly disagree	3.3%
Do not know/Not sure	5.8%

Participants were also asked what they consider the top two pressures to be on the health of the Great Barrier Reef (Table 47). The top pressures cited by cane growers were climate change and global warming (29%); urban run-off (18.8%); extreme weather events (e.g. cyclones) (14.8%); tourism industry (7.2%); and nutrient and sediment run-off (5.4%). They also cited rising sea temperature, poor land management practices, coral bleaching, shipping and oil spill, natural growth and decline, fishing activities, feral pigs, Crown-of-thorns starfish, government regulations and politics. There is also a tendency of blame shifting related to the health of the reef. Just over 1% of cane growers believe that cattle farmers and poor grazing practices are the top pressures on the health of the GBR.

Table 47: Land managers' perceptions

<i>The top pressures on the health of the GBR</i>	<i>Percent of cane growers (%)</i>	
	<i>Top pressure 1 N=223</i>	<i>Top pressure 2 N=193</i>
Climate change/Global warming	29.15%	7.77%
Urban run-off	18.83%	22.80%
Extreme weather events (e.g. cyclones)	14.80%	15.54%
Tourism pressure	7.17%	6.74%
Sediment/Nutrient run-off	5.38%	7.25%
Rising sea temperature/Water temperature	4.04%	4.66%
Poor land management practices/Farming systems	3.14%	5.70%
Coral bleaching	2.69%	1.04%
Shipping/Oil spill	2.24%	3.11%
Seasonal variability/Natural changes	2.24%	3.11%
Fertiliser/Chemicals	1.79%	3.11%
Fishing activities	1.79%	2.07%
Feral pigs	1.35%	3.11%
Crown-of-thorns starfish	0.90%	6.22%
Government regulations/Politics	0.90%	1.55%
Water quality	0.45%	2.59%
Poor grazing practices/Cattle		1.04%
Other (not specified)	1.79%	2.07%
No idea/No opinion/Not sure	1.35%	0.52%

3.2.12 Demographic background

As expected, the sample was dominated by males. Ninety - seven percent of cane growers identified as male and 3% identified as female. The majority of growers were born in Australia and 36% were non-Indigenous Australian. Another 36% of cane growers had Italian cultural heritage. Nearly 9% of growers were of Australian/Italian heritage, 3% were Maltese, 2.5% were English, 1.6% were Indian and the remaining 11% were of other cultural heritage including Albanian, Yugoslav, Chinese, and Finnish, Irish or mix of them. The majority of respondents were either married or in de facto relationships (>87%) (see Table 48).

Table 48: Demographic characteristics of cane growers

	<i>Percent of cane growers (%)</i>	
Gender (N=244)	Male	97.13%
	Female	2.87%
Born in Australia (N=246)	Yes	94.72%
	No	5.28%
Cultural Heritage (N=248)	Australian (non-indigenous)	36.69%
	Italian	36.69%
	Australian/Italian	8.87%
	Maltese	2.82%
	English	2.42%
	Indian	1.61%
	Other (e.g. Yugoslav, Albanian, Chinese, German, Croatian, Irish etc.)	10.89%
Marital status (N=246)	Married or De-factor	87.8%
	Divorced	2.03%
	Widowed	2.44%
	Single	7.72%

More than 61% of cane growers who answered the survey were aged between 50 and 69 years of age. Thirteen percent of cane growers aged 70+. Just over 3% of growers were between 20 and 34 years of age (Table 49). Medium age of cane growers was 57 years, which is significantly greater than the median age of the Australian population (37 years).

Table 49: Age of respondent (N=247)

<i>Age group</i>	<i>Percent of cane growers (%)</i>
20-24 years	0.40%
25-29 years	0.40%
30-34 years	2.43%
35-39 years	5.26%
40-44 years	8.50%
45-49 years	8.50%
50-54 years	14.57%
55-59 years	18.62%
60-64 years	15.79%
65-69 years	12.15%
70-74 years	5.67%
75-79 years	5.26%
80-84 years	1.62%
85 years and older	0.81%
Total	100.0%

Twenty-seven percent of cane growers answered that they have completed to year 10 and another 27% achieved a trade or apprenticeship. The other respondents either completed year 12 (12.5%) or went to agricultural college (9.3%). Only 7% of respondents answered that they have completed a university degree (Table 50).

Table 50: Highest level of education completed by respondent

<i>Education</i>	<i>Percent of cane growers (%)</i>
Primary school (year 7)	5.67%
Secondary school (year 9)	4.45%
High school (year 10)	27.53%
High school (year 12)	12.55%
Trade / apprenticeship	27.53%
Agricultural college	9.31%
TAFE	1.62%
Diploma of Agriculture/Certificate	3.24%
University	6.88%
Other*	1.21%

* Category 'Other' include Scholarship and University (not completed)

3.2.13 Additional property characteristics

Cane yield per hectare (per acre) achieved on the main property

Cane growers were asked to average out over good and bad years their cane yield per hectare (per acre) that they achieved on their property (Table 51). The majority of cane growers (68%) said that on average they achieved cane yield between 80 tonnes per ha (32.4 tonnes per ac) and 100 tonnes per ha (40.5 tonnes per ac).

Table 51: Average cane yield per hectare (per acre) (N=224)

<i>Tonnes per ha/ac</i>	<i>Percent of cane growers (%)</i>
20-40 tonnes per ha (8.1- 16.2 tonnes per ac)	0.4%
40-60 tonnes per ha (16.2-24.3 tonnes per ac)	0.4%
60-80 tonnes per ha (24.3-32.4 tonnes per ac)	21.0%
80-100 tonnes per ha (32.4-40.5 tonnes per ac)	67.9%
100-120 tonnes per ha (40.5- 48.6 tonnes per ac)	6.3%
120-140 tonnes per ha (48.6-56.6 tonnes per ac)	3.6%
140-160 tonnes per ha (56.6-64.7 tonnes per ac)	0.4%

4.0 Recommendations and conclusion

Note: The recommendations have already been provided in draft form to the CEO of Terrain NRM for comment. Further discussions will be needed to decide on how best to implement the recommended strategies. This preliminary analysis of the first round of data within the Wet Tropics area revealed no 'unexpected findings' that run contrary to previous studies as outlined in our 2016 literature review (Eagle, Hay, & Farr, 2016) and we have therefore cross referenced to specific sections of that report if additional information is required, adding in additional references where relevant. The responses from cane growers indicate that there is a reluctance to accept that their actions impact negatively on the water quality of the Great Barrier Reef. Survey results show that cane growers were reluctant to accept that nutrient loss from their property also has a negative impact on water quality in local streams, rivers and waterways. Cane growers have a tendency to shift blame to the other sectors, and to see issues of water quality as due to feral pigs in national parks and rainforest as well as due to soil run-off, riverbank erosion, and erosion from bare fallow and roads.

Drawing on the climate change adaptation literature, there is growing recognition of the need to reconsider the strategies for encouraging wider uptake of BMP and recognition of a need for more than incremental (small to moderate) changes to existing practice and a refocusing on more significant changes to practices (Dowd et al., 2014). We note that similar challenges exist in other parts of the world such as the EU (McGonigle et al., 2012). The recommendations that follow outline strategies that can be used to fine-tune existing landholder interactions.

Land Manager Profiles - Key Factors

- 27% of cane growers have completed year 10 high school and 27% of respondents completed trade / apprenticeship program.
- The majority of respondents are either married or in de-factor relationships.
- 37% of respondents have Italian cultural heritage.
- 65% of cane growers own their properties and 12% selected that they own and lease the property.
- 72% of participants indicate that growing sugarcane is the most important use of land to the financial viability of their farm and 66% were enjoying cane growing.

Mature profile – older than overall population

More than 61% of cane growers who answered the survey were aged between 50 and 69 years of age. The median age of cane growers and graziers is 57 years, which is significantly greater than the median age of the Australian population (37 years) (Australian Bureau of Statistics, 2016).

Lengthy land management experience

The majority of cane growers (77%) either own or own and lease their properties. Respondents have considerable land management experience (average of 32.7 years), often following earlier generations onto properties: *maintaining traditions and heritage* are important (over 63% of cane growers indicated this to be of the highest importance).

Decisions are not made in isolation – influence of family / extended family

Forty percent of cane growers share their decisions with family or extended family. Cane growers consult solely with spouses (28%) or with their brothers and sisters (26%), and parents (18%).

Positive about overall quality of life

Approximately 79% of respondents were either very satisfied or satisfied with their overall quality of life. The majority of cane growers (over 95%) had no significant plans to change future practices.

Blame shifting

Forty - two percent of cane growers do not believe their farming practice adversely affects water quality in local streams, rivers, and waterways. Forty-nine percent of cane growers do not believe that cane industry plays a significant role in the declining health of the GBR. Two percent of cane growers believe that overgrazing, livestock farming, and run-off from grazing are the main reasons for poor water quality in local streams, rivers, and waterways. Similarly, just over 1% of cane growers believe that producing cattle and poor grazing practices are the top pressures on the health of the GBR.

Selling the Science

As 42% of cane growers do not accept that their farming practices negatively impact water quality, there is a clear need to engage them in discussions on this issue and to 'prove' cause and effect in ways that will lead to engagement. This will require liaison with environmental science specialists to help 'sell the science' AND to offer practical and affordable behavioural practice advice, both in face-to-face and via meetings and workshops.

Extension Officers

Note: On the basis of discussions with stakeholders re the material below, the research team was asked to submit a paper for the 2017 International Conference of the Australasia-Pacific Extension Network (APEN) conference. This paper has been accepted and discussion will take place at the conference regarding appropriate strategies and tactics. A more extensive set of recommendations in the form of a full academic paper for submission to an appropriate journal will then be developed. The key role of extension officers in interactions with Australian land managers has been recognized (see, for example, Ampt, Cross, Ross, & Howie, 2015; Vanclay, 2004). The challenge now is to support officers at a regional level in their interactions, particularly in difficult relationships with land managers who hold entrenched views regarding the best practice for managing their own land, which also may be more difficult when there is a considerable difference between the land manager and extension officer ages. Land managers believe their expertise and opinions are not valued and their 'farmer voices' are not being heard, leading to scepticism regarding the need to change practice. Practice change requires building a level of trust that is needed for positive long-term relationships (Eagle et al., 2016, Section 1.3).

We note that the role of agricultural extension officers has altered over time, often as the result of major policy and funding changes and note that there are calls for a major professional development strategies to help these key individuals facilitate innovation and significant practice change (Ampt et al., 2015), with possible implications for on-going professional training. We now outline possible ways in which their role can be supported and strengthened.

Recommendations for an increased focus on the role of extension officers are not new, and are consistent across countries, including Australia (see, for example, Di Bella, O'Brien, Nash, & Wegscheidl, 2015; Hunt, Birch, Vanclay, & Coutts, 2014; Wegscheidl, Trendell, & Coutts, 2015), The USA (Warner, 2014; Warner, Stubbs, Murphrey, & Huynh, 2016) and Greece (Koutsouris, 2014). An American approach is noteworthy because of the recommendations that extension officers be given professional development training in social marketing techniques, particularly in the use of message framing and message tailoring techniques. The outcomes of this strategy are claimed to increase positive behaviour change but also the job satisfaction of extension officers together with their confidence in their ability to continue to influence behaviour change (Warner, 2014; Warner et al., 2016). It is noted that communications training improves active engagement particularly where there is added complexity caused by controversial topics such as the impact of climate change (Diehl et al., 2015).

Support for Innovators / Positive Deviants

Support for those land managers who have changed practice but who are seen by their peers as 'going against the norm' (described in the literature as 'positive deviants' (Pant & Hambly Odame, 2009) needs to be considered given the strength of comments from both cane growers and graziers. Survey comments indicate that "farmers I respect" (i.e. strong social norms as part of farmer identity) is a stronger influence than wider community factors, and that sharing new ideas is important (see the discussion of diffusion of innovation in Section 2.1 of the literature review, particularly the issues of compatibility, trialability and observability). 'Positive deviants' experiencing success are meeting their personal goals and expected outcomes of a particular practice. Meeting personal goals and expected outcomes are beliefs that are highlighted as important in the survey responses. Perceived control was also highlighted as important. Therefore, efforts to promote best management practice clearly and convincingly should demonstrate the ecological benefits, such as improving environment and enhancing land managers ability to participate in ecological conservation activities to meet the perceived control behaviour. This suggests opportunities for extension officers to facilitate group 'social learning' with land managers, to share ideas and to learn from and support each other (Hermans, Klerkx, & Roep, 2015) as part of strategies for "persuasion by discussion" (Scott, 2012, p. 64) and collective action (Blackstock, Ingram, Burton, Brown, & Slee, 2010).

Integrated marketing communication

There are a range of competing and conflicting messages received by land managers, including largely negative media coverage of issues relating to the health of the Great Barrier Reef, and messages from mills and farm supply merchants. We note that information overload appears to be an irritating factor for some land managers and recommend that a system be set up to monitor information from all sources and to combat messages that run counter to the desired core messages re BMP. There is a need for consistent messages to be sent, irrespective of the source with key informants being involved in message design and delivery where possible. Ideally this would be as part of an integrated communications strategy (Dahl, Eagle, & Low, 2015), using a combination of both traditional and digital media (Batra & Keller, 2016; Keller, 2016) that encompasses federal, state and local-originated material and encompasses all forms of communication, whether print, electronic or face-to-face advice as part of this integration. We note, however, that there is widespread distrust of government-originated information, therefore the source of information must be considered, along with the

readability issues identified in our earlier report (Hay & Eagle, 2016a) and also the communication channels preferred by land managers.

Proactive plans should be developed for combating or at least minimising the effects of competing and conflicting messages including negative media coverage (refer to Section 2.7 of the Literature Review). We have reviewed media coverage of the Great Barrier Reef during 2016 (excluding tourism-related coverage). The findings are summarised in Table 52 and indicate that the media presents a sensationalised and, at times, hostile perspective on reef-related issues.

Table 52: Great Barrier Reef 2016 Media coverage examples

Category	Example
<i>Climate change / Global Warming / Ocean Acidification (23 articles)</i>	<i>Ritter, D. (2016). Great Barrier Reef: why are government and business perpetuating the big lie? The Guardian, November 1.</i>
<i>Coral bleaching (42 articles)</i>	<i>Brissenden, M. (2016). Two-thirds of the northern Great Barrier Reef wiped out. ABC Radio, 29 November.</i>
<i>Reef is Dead / Dying (21 articles)</i>	<i>Marshall, P. & Smith, A. (2016). Outside magazine Great Barrier Reef wiped out. ing the big lie The Australian, 4 November.</i>
<i>“Peter Ridd controversy” (10 articles)</i>	<i>Micheal, P. (2016). Great Barrier Reef threat overstated, says Queensland professor. Courier Mail, May 19.</i>
<i>UNESCO potential ‘at risk’ listing (16 articles)</i>	<i>Day, J., Grech, A. & Brodie, J. (2016). Great Barrier Reef needs far more help than Australia claims in its latest report to UNESCO. The Conversation, 6 December.</i>
<i>Water quality improvement (4 articles)</i>	<i>Smail, S. (2016). Great Barrier Reef water quality improved by wetlands restoration, scientist says. ABC News, 14 June.</i>
<i>Funding increase calls (17 articles)</i>	<i>Michael, P., Viellaris, R. (2016). Great Barrier Reef Marine Park authority ‘starved of funds’. Courier Mail, 7 November.</i>
<i>Cane monitoring compliance measures (4 articles)</i>	<i>Anon. (2016). Queensland to enforce Great Barrier Reef protection methods with cane farmers. Envirotech-online.com, April 1.</i>
<i>Farmer protests at negative portrayal (4 articles)</i>	<i>McKillop, C. (2016). Great Barrier Reef debate leaves farmers frustrated over their negative portrayal on water quality improvements. ABC Rural, 29 June.</i>
<i>Government actions re reducing run-off (5 articles)</i>	<i>Gregory, K. (2016). Great Barrier Reef: Qld Government’s cattle station purchase ‘makes agriculture sector scapegoat’. ABC News, 23 June</i>
<i>Reef Report Card (5 articles)</i>	<i>Smail, S. (2016). Barrier Reef Reef: Report card reveals pollution levels too high. ABC News, 20 October.</i>
<i>Plastic bags (14 articles)</i>	<i>Aust Assoc Press (2016). Qld government seeks plastic bag ban reactions. November 25.</i>
<i>Coal mines (22 articles)</i>	<i>Knaus, C. (2016). Minister defends coal industry after call to ban new mines to save reef. The Guardian, 25 November.</i>
<i>Shipping</i>	<i>Whigham, N. (2016). Research shows the devastation of a potential coal spill on Great Barrier Reef. News.com, May 17.</i>

Social media strategies

There are some researchers who propose the “cyber extension” model, where the bulk of communications are electronic. This is a concept that has evolved from developing countries (Burman et al., 2013) but we recommend that this be viewed with some caution and that digital media communication be considered as part of a wider integrated communication strategy rather than replacing existing strategies. A strategy for the inclusion of strategic uses of social media may have several benefits. It may help to reach individuals who are hard to reach via conventional media (Quinton, 2013) or who resist face-to-face contact. It can be a low cost and fast way of distributing information (White, Meyers, Doerfert, & Irlbeck, 2014). However, we note that while there are claims that people “are swarming to social media” (Heller Baird & Parasnis, 2011, p. 31), internet use varies widely, including across the agricultural sector, with both insufficient / inadequate Internet connections and information overload being significant barriers (Jespersen et al., 2014).

There is a need to separate email (the most commonly used digital medium) from other electronic platforms AND to ensure that the platforms used are those that land managers can access and prefer to use, for example smart phone technology, tablets and laptops (Hay & Pearce, 2014, p. 322). In a recent study, land managers surveyed about the technology they use, identified that 87% were using smart/mobile phones, 86% were using laptops, 72% were using a tablet and another 72% were using a home PC (Hay, 2017). While having access to technology does allow communication with land managers via social media, we must keep in mind that 20% of the population of developing countries have literacy problems and a further 20% have limited literacy (see Hay & Eagle, 2016b, p. 2). Therefore, we must ensure that the platform used is appropriate and that the content is written at a level suitable to the audience. In addition, not all land managers have access to social communication platforms. Seventy three percent of respondents to a Regional Access Survey stated that they did not have reliable mobile coverage, 74% of mobile broadband users had download speeds of less than 5Mbps and that they had limited data (88% stated that current data did not meet their needs) (BIRRR Regional Internet Access Survey, 2016). Those connected to the Sky Muster nbn™ in some cases are experiencing even less connectivity (BIRRR Skymuster Survey Results, 2017). Overall message fatigue needs to be recognised as an additional barrier as it leads to both message avoidance and resistance irrespective of the media channel used (So, Kim, & Cohen, 2016). Where social media strategies are included, communication will be interactive, with participants generating content and no one individual or organisation being able to control the exchange of information (Dijkmans, Kerkhof, & Beukeboom, 2015). Further, organisations such as NRMs need to resource social media activity due to its proactive direct relationship between participants rather than the passive nature of one-way information distribution via more traditional media channels (Aula, 2010).

An additional factor to consider is the use of visual imagery. While visual imagery may at first gain attention and interest, it can also help those who struggle to understand the text-based information or other concepts (Dowse, 2004). It can also make specific elements of the communication stand out (Altinay, 2015). Where the topic has a high involvement for the farmer, the image becomes a central route to persuasion and may influence decisions. Likewise, when there is low involvement with the topic, imagery allows for low or non-conscious information processing, which may change an attitude toward the message or a non-conscious belief, leading to behavioural and/or attitude change (Petty & Cacioppo, 1984). Therefore, it is important that visual imagery is relevant and reflects the topic being presented. In addition,

local imagery is more effective when gaining acceptance or when there is a need for local action. Further investigation of current imagery will be completed in the upcoming NESP Project 3.1.3.

Customer relationship management plans

The application of Customer Relationship Management (CRM) principles in agriculture is relatively new but it is acknowledged that “a farmer’s commitment to their advisor will remain strong if they have frequent meaningful interaction over a long period of time, high perceptions of equity and value, trust and confidence” (Kuehne, Nettle, & Lellyn, 2015, p. 1). Therefore, CRM may be of use, in conjunction with the use of social network analysis, typologies and other strategies outlined in this document. Additionally, the principles of business-to-business marketing may be useful in recognizing long decision making cycles, complex decision making units and the importance of reference groups (Brennan, Canning, & McDowell, 2014)

Social network analysis

Given the evidence that decisions are generally not made by one single individual and that the views of ‘farmers I respect’ are important, we believe that there is value in considering the use of Social Network Analysis (SNA). A set of techniques used to analyse the social and informational contacts between individuals with graphical representation (‘sociograms’) that use dots or circles to represent individuals and lines to represent connections between them (Dempwolf & Lyles, 2012), as the following example of the connections between a group of 24 individuals illustrates.

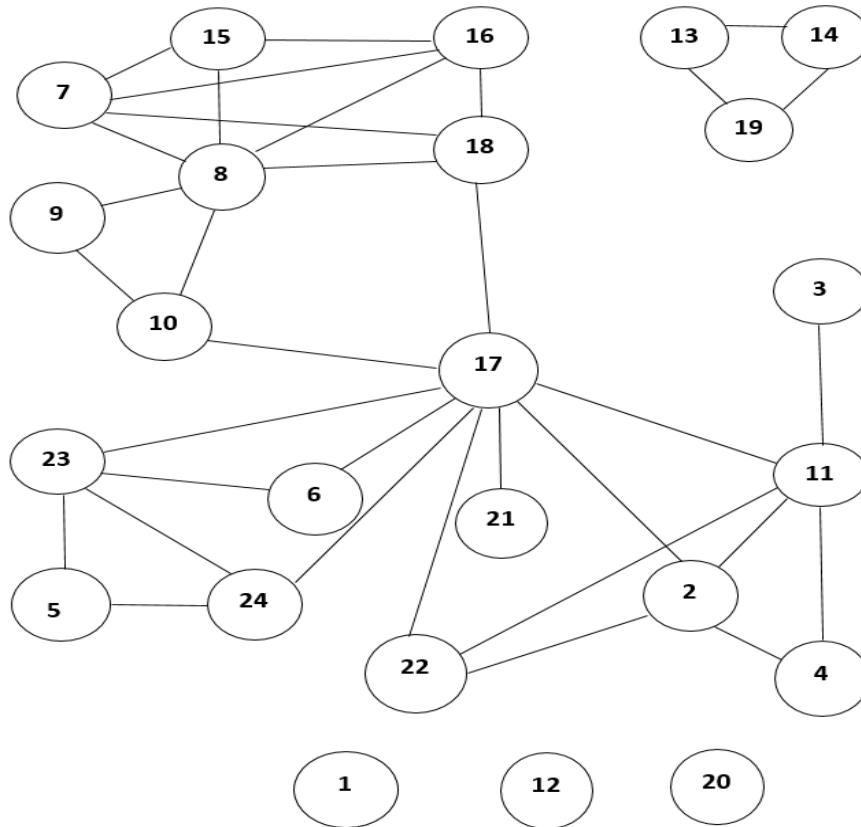


Figure 2: Social network Analysis Example: ‘Sociogram’ of 24 people (Scott, 2012, p. 29 reproduced from Moreno, 1934, p. 145)

The sociogram in Figure 2 shows that there are three individuals who are not connected to any others (individuals 1, 12 and 20), three that are connected only to two other people (individuals 13, 14 and 19), while all other individuals are connected to a wider group. Within this ‘connected’ group, individual 17 is an example of someone with multiple connections and who should be examined to determine their actual or potential role as an information gatekeepers or opinion leaders and also what role they may play in decision-making among those other individuals with whom they are connected. These people may be valuable in helping to ‘sell the science’, particularly through information sharing and facilitating actual demonstrations of practice change.

The value of SNA in the agri-environment context will lie in analysing the flow of information and discussions, and in particular in identifying the extent of influence of key information gatekeepers and opinion leaders who may have either power or influence over the adoption of innovations. It overcomes the limitations of analysis based only on geographic proximity by analysing social relationships that may be based on kinship or other factors. Advanced analysis can identify the strength of ties or connections between individuals (Prell, Hubacek, & Reed, 2009), as the impact of these two types of ties are different as shown in Table 53 below, with both positive and negative implications.

Table 53: Network concepts relevant for natural resource management (adapted from Prell et al., 2009, p. 505) + indicates positive effect, - indicates negative effect

<i>Network concept</i>	<i>Effect on resource management</i>
Strong ties	
+	Good for communicating about and working with complex information
+	Hold and maintain trust between actors
+	Actors more likely to influence one another's thoughts, views, and behaviours
+	Encourage creation and maintenance of norms of trust and reciprocity
-	Encourage the likelihood that actors sharing strong tie hold redundant information
-	Actors less likely to be exposed to new ideas and thus may be less innovative
-	Can constrain actors
Weak ties	
+	Tend to bridge across diverse actors and groups
+	Connect otherwise disconnected segments of the network together
+	Good for communicating about and working with simple tasks
+	New information tends to flow through these ties
-	Not ideal for complex tasks=information
-	Actors sharing weak ties are less likely to trust one another
-	Can break more easily

It may therefore be useful to attempt to map out social networks for land managers where there is the potential for identifiable individuals to play a key role, positive or negative, in information dissemination. It may also be useful for extension officers to map networks for the land managers with whom they interact and to consider their own roles within these networks.

The ability of an individual (also called 'actors' in recent academic literature) or an organization to disseminate or manipulate knowledge depends on how many other individuals look to them as a credible source of information and knowledge (Muñoz-Erickson & Cutts, 2016).

Early adopters have larger numbers of social contacts and influence the rate of adoption because of their role in those networks (Dowd et al., 2014). However ideas will only be taken up if there is a favourable attitude towards them, which occurs when "others who he or she have cause to trust are considering it or have already adopted it" (Scott, 2012, p. 69). Thus, these key people may act as a significant barrier to uptake of innovations (see the discussion of diffusion of innovation in Eagle et al., 2016, Section 2.1)

It is related to other concepts such as social capital (see Eagle et al., 2016, Section 4.1.3) and to the concepts of networks or communities of practice which evolved from the education sector. Communities of practice are defined as "groups of people who share a common pursuit, activity or concern. Members do not necessarily work together, but form a common identity and understanding through their common interests and interactions" (Oreszczyn, Lane, & Carr, 2010, p. 405). These authors suggest that networks of practice have weaker ties between members and may be linked by shared practice.

Typologies

The diversity of farmers and farming practice is acknowledged, but it is useful to consider the role of typologies in developing resources to aid extension officers in their interactions with land managers through the identification of the range decision-making drivers and the types of land managers who are motivated by similar drivers (Graymore, Schwarz, & Brownell, 2015). Shrapnel and Davie (2001) used semi structure interviews to discover the dominant personality styles of cattle and crop producers in Queensland. Five dominant personality styles emerged which may be used to direct learning (Table 54). For example the “vigilant personality” values autonomy, therefore may prefer a one on one approach to information gathering. Whereas the “solitary personality” feels comfortable alone, and prefers not to deal with people at all, therefore may suit an online learning environment or learning from trade magazines or television. The “serious personality” is not outgoing and does not like to be told things and would value information sharing in educated groups, and by contrast, the “sensitive personality” is cautious when in groups, and is stressed by unfamiliar surrounds, therefore would learn better in small groups of familiar people for example extension staff (Shrapnel & Davie, 2001). Recognising producers as having unique personality traits is a large step towards shared understanding.

Table 54: Characteristics of the dominant personality Styles (reproduced from Shrapnel and Davie, 2001)

Personality Style				
<i>Vigilant</i>	<i>Conscientious</i>	<i>Solitary</i>	<i>Serious</i>	<i>Sensitive</i>
Autonomy	Hard Work	Solitude	Cogitates	Needs Familiarity
Caution	Does the right thing	Stoicism	Keeps a straight face	Circumspect
Perceptiveness	Order and detail	Sexual composure	Dislikes pretensions	Likes a structured role
Self defence	Prudence	Sangfroid	Predictable	Reserved
Fidelity	Perseverance	Grounded	Accountable	Very private
Alertness to criticism	Perfectionist Accumulator	Independence	Contrite Insightful	Concerned about other regards

Summary of our key recommendations are given below:

- There is a need to 'sell the science' to gain acceptance of the cause-effect relationship between farming practice and water quality. NRM groups should work with environmental science specialists to change views on the impact of farming practice on water quality.
- There is a potential to extend the key role of extension officers in potentially influencing increased uptake of BMP practices. There is a need to recognise the key role of extension officers and determine what professional development support might be beneficial in continuing to build trust and engagement with land managers.
- It is crucial to support innovation by celebrating success and sharing ideas. Land managers should see their expertise is valued and their voices heard.
- Facilitating sharing of ideas and practices.
- Building on the role of farms whose views are respected as information gatekeepers / disseminators / role models.
- A need to ensure all communication, by whatever means, sends consistent messages irrespective of source, and channelling communication through trusted sources. Developing strategies for minimising the impact of competing and conflicting messages.
- Ensuring that all persuasive communications are integrated in terms of key messages.
- Monitor media coverage and respond to inaccurate messages and develop proactive media relationships.
- Incorporating social media strategies as part of an integrated communication strategy that centres on the information channels and platforms used and preferred by land managers. Review communication strategies, adding social media where appropriate, recognising that this is likely to be most popular with younger land managers. Need to recognise the overall diversity of information sources and preferences.
- Incorporate long-term relationship management strategies based on customer relationship management and business-to-business marketing concepts.
- Utilise Social Network Analysis to identify:
 - Key information gatekeepers / opinion leaders who may help or hinder information dissemination and innovation uptake, and recognise social relationships based on cultural / kinship factors.
 - Where individual extension officers may fit into various networks
- Recognise land manager diversity but use typology principles to develop material and communication approaches to support extension officers in their interactions with specific subsets of land managers.

The analysis of data presented in this report is primarily descriptive. The results of full structural equation based analysis will be provided in the next reporting period, with findings linked back to the literature and the implications for future water quality improvement practices will be discussed.

REFERENCES

- Ajzen, I., & Fishbein, M. (1980). *Understanding Attitudes and Predicting Social Behavior*. Engelwood Cliffs, NJ: Prentice Hall
- Altinay, Z. M. (2015). Communicating Sustainability with Visuals: Issue Perception and Issue Engagement. (PhD), Louisiana State University.
- Ampt, P., Cross, R., Ross, H., & Howie, B. (2015). The case for retaining, redefining and reinvigorating extension in agricultural innovation systems. *Rural Extension and Innovation Systems Journal*, 11(1), 157.
- Ashburner, B., Shannon, E., DiBella, L., & Hurney, A. (2012). Compendium of Smart Sugar Practices -A summary of well-established best practices for profitability and sustainability in Australia's tropical sugar cane industry.
- Atkin, C. K., & Chaffee, S. H. (1972). Instrumental response strategies in opinion interviews. *Public Opinion Quarterly*, 36(1), 69-79.
- Aula, P. (2010). Social media, reputation risk and ambient publicity management. *Strategy & Leadership*, 38(6), 43-49.
- Australian and Queensland governments (2016). *Great Barrier Reef Report Card 2015 Results*. State of Queensland, Brisbane.
- Australian Bureau of Statistics. (2016). 3101.0 Australian Demographic Statistics. Canberra, ACT.
- Australian Government Department of Environment and Energy (2016). *Reef Trust Phase Three Investment Programme*. Available from <https://www.environment.gov.au/marine/gbr/reef-trust/investments/phase-three> (accessed 30 November 2016)
- Babbie, E. R. (1998). *The practice of social research*. International Thomson Publishing Services.
- Batra, R., & Keller, K. L. (2016). Integrating Marketing Communications: New Findings, New Lessons, and New Ideas. *Journal of Marketing*, 80(6), 122-145.
- Benn, K.E. (2013) The barriers to adoption of recommended fertiliser use practices by sugarcane growers in the Wet Tropics. PhD thesis, James Cook University.
- Bernardi, R. A., & Adamaitis, K. L. (2006). *Data contamination by social desirability response bias*. In Research on Professional Responsibility and Ethics in Accounting (pp. 149-175). Emerald Group Publishing Limited.
- BIRRR. (2016). Better Internet for Rural, Regional and Remote Australia: Regional Internet Access Survey Results, 2016. Retrieved from <https://birrraus.files.wordpress.com/2017/04/birrr-report-2016-survey-results-final.pdf>:
- BIRRR Skymuster Survey Results. (2017). Better Internet for Rural, Regional and Remote Australia: Skymuster Survey Results 2017. Retrieved from <https://birrraus.files.wordpress.com/2017/04/birrr-report-2016-survey-results-final.pdf>:
- Blackstock, K. L., Ingram, J., Burton, R., Brown, K. M., & Slee, B. (2010). Understanding and influencing behaviour change by farmers to improve water quality. *Science of The Total Environment*, 408(23), 5631-5638. doi:10.1016/j.scitotenv.2009.04.029

- Brennan, R., Canning, L., & McDowell, R. (2014). *Business-to-Business Marketing* (3rd ed.). London: SAGE Publishing.
- Brodie, J., McKergow, L.A., Prosser, I.P., Furnas, M., Hughes, A.O., Hunter, H. (2003). *Sources of sediment and nutrient exports to the Great Barrier Reef World Heritage Area*. ACTFR Report No. 03/ 11, Australian Centre for Tropical Freshwater Research, James Cook University, Townsville, 191p.
- Brodie, J., Waterhouse, J., Maynard, J., Bennett, J., Furnas, M., Devlin, M., Lewis, S., Collier, C., Schaffelke, B., Fabricius, K., Petus, C., da Silva, E., Zeh, D., Randall, L., Brando, V., McKenzie, L.J., O'Brien, D., Smith, R., Warne, M.S.J., Brinkman, R., Tonin, H., Bainbridge, Z., Bartley, R., Negri, A., Turner, R.D.R., Davis, A., Bentley, C., Mueller, J., Alvarez-Romero, J.G., Henry, N., Waters, D., Yorkston, H., & Tracey, D. (2013). *Assessment of the relative risk of water quality to ecosystems of the Great Barrier Reef: A report to the Department of the Environment and Heritage Protection, Centre for Tropical Water and Aquatic Ecosystem Research*. James Cook University, Townsville.
- Burman, R. R., Dubey, S., Sharma, J., Vijayaragavan, K., Sangeetha, V., & Singh, I. (2013). Information Dynamics for Designing Cyber Extension Model for Agricultural Development. *Journal of Community Mobilization and Sustainable Development*, 8(2), 182-185.
- Cantor, D., O'Hare, B., & O'Connor, K. (2008). The use of monetary incentives to reduce non-response in random digit dial telephone surveys. In *Advances in telephone survey methodology*, eds. J.M. Lepkowski, C. Tucker, J. M. Brick, E. de Leeuw, L. Japac, P.J. Lavrakas, M.W. Link, & R.L. Sangster, 471–98. New York, NY: Wiley.
- Cheshire, H., Ofstedal, M. B., Scholes, S., & Schroeder, M. (2011). A comparison of response rates in the English Longitudinal Study of Ageing and the Health and Retirement Study. *Longitudinal and life course studies*, 2(2), 127.
- Churchill, M., Farr, M., Eagle, L. and Hay, R. (2017). Getting the 'best bang for your buck': which land management practices achieve the best water quality outcomes, and the greatest uptake? NESP Project 2.1.3. Unpublished report to the National Environmental Science Programme. Reef and Rainforest Research Centre Limited, Cairns.
- Corral-Verdugo, V. C. (1997). Dual 'realities' of conservation behaviour: Self – reports vs observations of re-use and recycling behaviour. *Journal of Environmental Psychology*, 17(2), 135-145.
- Dahl, S., Eagle, L., & Low, D. (2015). Integrated marketing communications and social marketing: Together for the common good? *Journal of Social Marketing*, 5(3), 226-240.
- Dalton, D., & Ortegren, M. (2011). Gender differences in ethics research: The importance of controlling for the social desirability response bias. *Journal of Business Ethics*, 73-93.
- Dempwolf, C. S., & Lyles, L. W. (2012). The uses of social network analysis in planning: A review of the literature. *CPL bibliography*, 27(1), 3-21.
- Denzin, N. (1970). *Sociological methods: A sourcebook*. Chicago, Illinois: Aldine Publishing
- Department of Environment and Heritage Protection [DEHP] (2015). *Wet Tropics regional summary*. Available from <http://www.reefplan.qld.gov.au/about/regions/wet-tropics/wet-tropics-first-report-card/> (accessed 14 September 2016).

- Department of Natural Resources and Mines (2014). *Wet Tropics Water Resource Plan - Consultation Report*. Available from https://www.dnrm.qld.gov.au/__data/assets/pdf_file/0003/123672/wet-tropics-wrp-consultation-report.pdf (accessed 15 September 2016).
- Di Bella, L., O'Brien, D., Nash, M., & Wegscheidl, C. (2015). Targeted extension strategies to improve water quality outcomes in the Australian sugar industry. *Rural Extension and Innovation Systems Journal*, 11(1), 184.
- Diehl, D. C., Galindo-Gonzalez, S., Dourte, D. R., Fraisse, C. W., Sloan, N. L., Bartels, W.-L., & Furman, C. (2015). Toward engagement in climate training: Findings from interviews with agricultural extension professionals. *Journal of Rural Social Sciences*, 30(1), 25.
- Dijkmans, C., Kerkhof, P., & Beukeboom, C. J. (2015). A stage to engage: Social media use and corporate reputation.
- Dowd, A.-M., Marshall, N., Fleming, A., Jakku, E., Gaillard, E., & Howden, M. (2014). The role of networks in transforming Australian agriculture. *Nature Climate Change*, 4(7), 558-563.
- Dowse, R. (2004). Using visuals to communicate medicine information to patients with low literacy. *Adult learning*, 15(1-2), 22.
- Eagle, L., Hay, R., Farr, M. (2016). Background Review of Literature on the Science of Social Marketing for NESP Project 2.1.3 Harnessing the Science of social marketing and behaviour change for improved water quality in the GBR. Report to the National Environmental Science Programme. Reef and Rainforest Research Centre Limited, Cairns.
- Emtage, N., & Herbohn, J. (2012). Assessing rural land managers diversity in the Wet Tropics region of Queensland, Australia in relation to natural resource management programs: A market segmentation approach. *Agricultural Systems*, 110, 107-118.
- Farr, M., Eagle, L., and Hay, R. (2017a) *Key Determinants of pro-environmental behaviour of land managers in the agricultural sector: Literature Review*. NESP Project 2.1.3 Supplementary review. Report to the National Environmental Science Programme. Reef and Rainforest Research Centre Limited, Cairns (97pp.).
- Farr, M., Eagle, L. Hay, R., and Churchill, M. (2017b) *Questionnaire Design, Sampling Strategy and Preliminary Findings (The Burdekin region)*. NESP Project 2.1.3 Interim report. Report to the National Environmental Science Programme. Reef and Rainforest Research Centre Limited, Cairns (140pp.).
- Fernandes, M. F., & Randall, D. M. (1992). The nature of social desirability response effects in ethics research. *Business Ethics Quarterly*, 2(02), 183-205.
- Fisher, R. J. (1993). Social desirability bias and the validity of indirect questioning. *Journal of Consumer Research*, 20(2), 303-315.
- Flick, B. (2013). Landowners' management of riparian forest in far north Queensland, Australia: A social psychological prospective. PhD Thesis, James Cook University.
- Fuj, E. T., Hennessy, M., & Mak, J. (1985). An evaluation of the validity and reliability of survey response data on household electricity conservation. *Evaluation Review*, 9(1), 93-104.

- Gaes, G. G., Kalle, R. J., & Tedeschi, J. T. (1978). Impression management in the forced compliance situation: Two studies using the bogus pipeline. *Journal of Experimental Social Psychology, 14*(5), 493-510.
- Goldenberg, K.L., McGrath, D., & Tan, L. (2009). The effects of incentives on the consumer expenditure interview survey. In *JSM proceedings*, 5985–99. Alexandria, VA: American Statistical Association.
- Göritz, A.S. (2006). Incentives in Web studies: Methodological issues and a review. *International Journal of Internet Science, 1* (1), 58–70.
- Göritz, A.S. (2010). Using lotteries, loyalty points, and other incentives to increase participant response and completion. In *Advanced methods for conducting online behavioral research*, eds. S.D. Gosling & J. A. Johnson. Washington, DC: American Psychological Association.
- Graymore, M., Schwarz, I., & Brownell, B. (2015). Development of quick tool for farmer segmentation: Practical uses for extension work. *Rural Extension and Innovation Systems Journal, 11*(1), 33.
- Greiner, R., & Miller, O. (2008). *Environmental duty of care: Concept and relevance for graziers in the Northern Gulf region of Queensland*. Report prepared for the Northern Gulf Resource Management Group. River Consulting. Townsville.
- Groves, G. M. (1989). *Survey Errors and Survey Costs*. Wiley, New York.
- Hay, R. (2017). PhD Thesis - Initial Analysis of Survey Data: Technology Adoption by Women in Agriculture Survey 2016. Technology Adoption by Women in Agriculture. College of Business Law and Governance. James Cook University.
- Hay, R., & Eagle, L. (2016a). Harnessing the science of social marketing and behaviour change for improved water quality in the GBR: Documentary Analysis. Townsville: James Cook University for National Environmental Science Programme Project 2.1.3.
- Hay, R., & Eagle, L. (2016b). Harnessing the science of social marketing and behaviour change for improved water quality in the GBR: Documentary Analysis (readability, message framing and message tone). Retrieved from <http://nesptropical.edu.au/wp-content/uploads/2017/01/NESP-TWQ-2.1.3-INTERIM-REPORT-2.pdf>:
- Hay, R., & Pearce, P. (2014). Technology adoption by rural women in Queensland, Australia: Women driving technology from the homestead for the paddock. *Journal of Rural Studies, 36*, 318-327.
- Heller Baird, C., & Parasnis, G. (2011). From social media to social customer relationship management. *Strategy & Leadership, 39*(5), 30-37.
- Hermans, F., Klerkx, L., & Roep, D. (2015). Structural conditions for collaboration and learning in innovation networks: using an innovation system performance lens to analyse agricultural knowledge systems. *The Journal of Agricultural Education and Extension, 21*(1), 35-54.
- Hunt, W., Birch, C., Vanclay, F., & Coutts, J. (2014). Recommendations arising from an analysis of changes to the Australian agricultural research, development and extension system. *Food Policy, 44*, 129-141.

- Jespersen, L. M., Hansen, J. P., Brunori, G., Jensen, A. L., Holst, K., Mathiesen, C., & Rasmussen, I. (2014). ICT and social media as drivers of multi-actor innovation in agriculture—barriers, recommendations and potentials. European Commission, Directorate-General for Research.
- Keller, K. L. (2016). Unlocking the Power of Integrated Marketing Communications: How Integrated Is Your IMC Program? *Journal of Advertising*, 45(3), 286-301.
- Koutsouris, A. (2014). Exploring the emerging intermediation roles (facilitation and brokerage) in agricultural extension education. *International Journal of Agricultural Extension*, 21-37.
- Kuehne, G., Nettle, R., & Llellyn, R. (2015). The Key Social Processes Sustaining the Farmer/Adviser Relationship.
- Laurie, H., & Lynn, P. (2009). The use of respondent incentives on longitudinal surveys. In: (P. Lynn, ed.) *Methodology of longitudinal surveys*. Wiley, New York. pp. 205–233.
- Leggett, C. G., Kleckner, N. S., Boyle, K. J., Dufield, J. W., & Mitchell, R. C. (2003). Social desirability bias in contingent valuation surveys administered through in-person interviews. *Land Economics*, 79(4), 561-575.
- Loomis, J. B. (2014). Strategies for overcoming hypothetical bias in stated preference surveys. *Journal of Agricultural and Resource Economics*, 39(1), 34-46.
- Lusk, J. L., & Norwood, F. B. (2009). An inferred valuation method. *Land Economics*, 85(3), 500-514.
- McGonigle, D., Harris, R., McCamphill, C., Kirk, S., Dils, R., Macdonald, J., & Bailey, S. (2012). Towards a more strategic approach to research to support catchment-based policy approaches to mitigate agricultural water pollution: A UK case-study. *Environmental Science & Policy*, 24, 4-14.
- Muñoz-Erickson, T. A., & Cutts, B. B. (2016). Structural dimensions of knowledge-action networks for sustainability. *Current Opinion in Environmental Sustainability*, 18, 56-64.
- Norwood, F. B., & Lusk, J. L. (2011). A calibrated auction-conjoint valuation method: valuing pork and eggs produced under differing animal welfare conditions. *Journal of Environmental Economics and Management*, 62(1), 80-94.
- Oreszczyn, S., Lane, A., & Carr, S. (2010). The role of networks of practice and webs of influencers on farmers' engagement with and learning about agricultural innovations. *Journal of Rural Studies*, 26(4), 404-417.
- Pant, L. P., & Hambly Odame, H. (2009). The promise of positive deviants: bridging divides between scientific research and local practices in smallholder agriculture. *Knowledge management for development journal*, 5(2), 160-172.
- Petty, R. E., & Cacioppo, J. T. (1984). Source Factors and the Elaboration Likelihood Model of Persuasion. *Advances in Consumer Research*, 11(1), 668-672.
- Prell, C., Hubacek, K., & Reed, M. (2009). Stakeholder analysis and social network analysis in natural resource management. *Society and Natural Resources*, 22(6), 501-518.
- Quinton, S. (2013). The digital era requires new knowledge to develop relevant CRM strategy: A cry for adopting social media research methods to elicit this new knowledge. *Journal of Strategic Marketing*, 21(5), 402-412.

- Randall, D. M., & Fernandes, M. F. (1991). The social desirability response bias in ethics research. *Journal of business ethics*, 10(11), 805-817.
- Ryu, E., Couper, M.P., & Marans, R.W. (2006). Survey incentives: Cash vs. in-kind; face-to-face vs. mail; response rate vs. nonresponse error. *International Journal of Public Opinion Research*, 18 (1), 89–106.
- Scott, J. (2012). *What is Social Network Analysis*. London: Bloomsbury Academic.
- Shrapnel, M., & Davie, J. (2001). The influence of personality in determining farmer responsiveness to risk. *The Journal of agricultural education and extension*, 7(3), 167-178.
- Singer, E., & Ye, C. (2013). The use and effects of incentives in surveys. *The ANNALS of the American Academy of Political and Social Science*, 645(1), 112-141.
- Singer, E., & Kulka, R.A. (2002). Paying respondents for survey participation. In *Studies of welfare populations: Data collection and research issues*, eds. M. Ver Ploeg, R.A. Moffitt, & C.F. Citro, 105–28. Washington, DC: National Academy Press.
- Smith, M., Poggio, M. J., Thompson, M. & Collier, A. (2014). *The Economics of Pesticide Management Practices on Sugarcane Farms: Final Synthesis Report*. Department of Agriculture, Fisheries and Forestry (DAFF), Queensland.
- So, J., Kim, S., & Cohen, H. (2016). Message fatigue: Conceptual definition, operationalization, and correlates. *Communication Monographs*, 1-25.
- Thorburn, P., Wilkinson, S., & Silburn, D. (2013). Water quality in agricultural lands draining to the Great Barrier Reef: a review of causes, management and priorities. *Agriculture, Ecosystems & Environment*, 180, 4-20.
- Turnour, J., Dale, A., McShane, C., Thompson, M., Prideaux, B., & Atkinson, M. (2015). *Promoting agriculture in the Wet Tropics, North Queensland*. (Report 15/005). Canberra: Rural Industries Research and Development Corporation.
- van Grieken, M., Roebeling, P., Bohnet, I., Whitten, S., & Webster, A. (2012). Economic incentive-based instruments for the adoption of management options for water quality improvement in heterogeneous sugarcane farming communities. Paper presented at the International Environmental Modelling and Software Society (iEMSs). 2012 International Congress on Environmental Modelling and Software, Managing Resources of a Limited Planet, Sixth Biennial Meeting, Leipzig, Germany.
- Vanclay, F. (2004). Social principles for agricultural extension to assist in the promotion of natural resource management. *Animal Production Science*, 44(3), 213-222.
- Warner, L. A. (2014). Enhancing the capacity to create behavior change: Extension key leaders' opinions about social marketing and evaluation. *Journal of Agricultural Education*, 55(4), 176-190.
- Warner, L. A., Stubbs, E., Murphrey, T. P., & Huynh, P. (2016). Identification of the Competencies Needed to Apply Social Marketing to Extension Programming: Results of a Delphi Study. *Journal of Agricultural Education*, 57(2), 14-32.
- Wegscheidl, C., Trendell, P., & Coutts, J. (2015). Evaluating the role of extension in helping to improve water quality in the Great Barrier Reef. *Rural Extension and Innovation Systems Journal*, 11(1), 1.

- Welters, R., & Muysken, J. (2008). Inferring employer search behaviour from wage subsidy participation. *Labour economics*, 15(5), 844-858.
- White, D., Meyers, C., Doerfert, D., & Irlbeck, E. (2014). Exploring agriculturalists' use of social media for agricultural marketing. *Journal of Applied Communications*, 98(4), 72-86.
- White, R. T., & Arzi, H. J. (2005). Longitudinal Studies: Designs, Validity, Practicality, and Value. *Research in Science Education*, 35(1), 137-149. doi: 10.1007/s11165-004-3437-y

Appendix 1: Cane Grower Survey

Project 2.1.3: Harnessing the science of social marketing and behaviour change for improved water quality in the GBR: an action research project

Wet Tropics Sugar Industry Partnership (WTSIP)
& Terrain NRM

Cane Growers Survey 2016



The Wet Tropics Sugar Industry Partnership (WTSIP), Terrain NRM and a team from James Cook University are working together to evaluate the training programmes, grants and tenders that the government uses when trying to support land managers to control erosion and reduce nitrogen use. We hope you will agree to be part of this study. We would be very grateful for your input and the opportunity to learn from your experiences.



Project 2.1.3: Harnessing the science of social marketing and behaviour change for improved water quality in the GBR: an action research project

The Wet Tropics Sugar Industry Partnership, Terrain NRM and a team from James Cook University are working together to evaluate the training programmes, grants and tenders that the government uses when trying to support land managers to control erosion and reduce nitrogen use. We hope you will agree to be part of this study. We would be very grateful for your input and the opportunity to learn from your experiences.

We know that your time is valuable. In recognition of this, by completing this survey you can go into the draw to win a Drone worth \$1500 or equivalent value in cash or a travel voucher.

Completing the survey will take approximately 30 to 40 minutes.

We will contact you again in 2017 and 2018 with a much shorter survey.

Participation is entirely voluntary and you can stop taking part in the study at any time without explanation. We very much appreciate the time you are taking to complete the survey.

Would you like to begin the survey now?

If you have any questions about the study or if you are interested in the results, please contact:

Professor Lynne Eagle
College of Business, Law and Governance
James Cook University
Phone: (07) 4781 5717
Email: lynne.eagle@jcu.edu.au

Dr Marina Farr
College of Business, Law and Governance
James Cook University
Phone: (07) 4781 5014
Email: marina.farr@jcu.edu.au

Mrs Rachel Hay
College of Business, Law and Governance
James Cook University
Phone: (07) 4781 3131
Email: rachel.hay@jcu.edu.au

If you have any concerns regarding the ethical conduct of the study, please contact: Human Ethics, Research Office, James Cook University, Townsville, QLD 4811 Phone: (07) 4781 5011 (ethics@jcu.edu.au)

This project is supported through funding from the Australian Government's National Environmental Science Programme

First, some background information about you and your property (you may be asked to answer questions in Hectares or Acres, please only answer using one measurement).

Land Holder ID:

Wet Tropics Sugar District:

1. Who makes decisions relating to land-management and farming on your property, or if you own more than one, who makes decisions on your main property?

Entirely my decision (i.e. individual) Majority of decision is mine Joint/Shared decision

If joint/shared decision, could you please tell us who is involved? (Please tick all that apply)

- Spouse
 Parents
 Children
 Brother/Sister
 In-laws
 Other (please specify) _____

2. Do you own or manage other properties? (Please tick) Yes (fill in details below) No (go to Q3)

If yes, please tell us where the properties are, and what the land is (mostly) used for:

Location (e.g. nearest town)	Approximate Area		Main land-use (e.g. cane, grazing, sugar, horticulture)	
	Hectares	Acres	Hectares	Acres

3. Do you (or your spouse, if relevant) have an off-farm 'job'? (Please tick)

You	Your spouse
<input type="checkbox"/> No (Go to Q4)	<input type="checkbox"/> No (Go to Q4)
<input type="checkbox"/> Yes, I work less than 20 hours per week off-farm	<input type="checkbox"/> Yes, she/he works less than 20 hours per week off-farm
<input type="checkbox"/> Yes, I work more than 20 hours per week off-farm	<input type="checkbox"/> Yes, she/he works more than 20 hours per week off-farm

4. How many people live on your main farm/property? _____

5. Do you manage or own/lease/share main farm/property or both? (Please tick all that apply)

- Manage (skip to Q6)
 Own (please answer below)
 Lease (please answer below)
 Share (please answer below)

If own/leased/shared, approximately what percent of the property is:

Owned ____ % Leased ____ % Shared ____ %

6. How many years have you owned/managed your main property? _____

7. Please provide us with some background information about land-use on your main property

Land use (e.g. grazing, sugar, bananas, rice)	Approximate area used for this (e.g. 10ha for sugar)	
	Ha	Ac

Which of those land-uses is most important to the FINANCIAL VIABILITY of your property? (if off-farm income is most important, please write 'off farm') _____

Which of those land-uses do you ENJOY doing the most (if off-farm activities are the most enjoyable, write 'off farm') _____

8. Are there any other properties on which you would like to comment?

Yes (please comment below) No (Go to Q9)

9. On average, is the revenue from the last year better, worse or the same as previous years?
(Please select one)

- This year's revenue is better than previous years
 This year's revenue is worse than previous years
 This year's revenue is about the same as previous years

Next, we ask for some background information on what 'drives' you and about your overall sense of well-being.

We would like to better understand the factors that influence your decisions and choices related to your personal goals for your farm/property. Life satisfaction or happiness depends on many things and we would like to know which things make you the most and the least happy.

10. Please think about your own personal goals and aspirations for your farm/property. What are the two most important things you hope to achieve (your goals) for your farm / property?

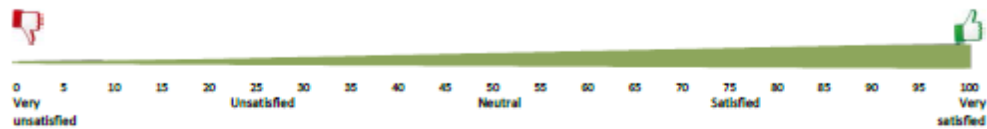
1) _____

2) _____

11. How important are each of the following to you, when making decisions about what to do on your farm / property

	Extremely unimportant (irrelevant)		Neutral		Extremely important (essential)		Do not know
Maintaining physical and mental health of family	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maintaining family traditions and heritage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spending face-to-face time with family and friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Keeping in contact with family and friends in other ways (e.g. via phone, through social media)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maintaining good relations with other farmers/graziers in the local area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Keeping farm costs low	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Keeping a stable (steady) cash-flow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maximising farm profits (income minus costs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Minimising risk (of very high costs or very low income)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Servicing debt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Having time to pursue hobbies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Being able to make your own decisions about your farm/property	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Learning about and testing new ways of doing things on your farm/property	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sharing new ideas with others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Having efforts recognised by the wider community	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Leaving the land/farm in better condition than it was when you first started managing it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maintaining/improving water supplies and storages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Minimising sediment run-off and/or nutrient losses	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Helping to safeguard native plants and animals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Helping to safeguard local waterways	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Helping to safeguard the Great Barrier Reef	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. Please think about your own life and personal circumstances (yes, this is a 'big' question!). How satisfied are you with your quality of life as a whole? (Please circle a number)



13. Why do you feel this way?

Next, we would like to know about attitudes towards programs that are designed to help you manage your land

We would like to know your opinion about the usefulness of the programs; and where you look for information about grants, workshops and training associated with land management

14. There are many different ways/places you can apply for grants and/or financial assistance to do things on your property (e.g. Reef Rescue, Reef Program, Reef Trust, Drought assistance, cheap electricity). Please tell us about the grants you have applied for by answering the following questions (if you have applied for more than three (3), just tell us about the most recent applications).

Please tick if you have applied for more than three (3) grants in the last 5 years yes

Name of grant/financial assistance program that you applied for...	Year you applied	How did you find out about it? (e.g. friend, google, extension officer)	Was your application successful? (tick if yes)	What was the most important thing you hoped to achieve with this grant?	How useful was the grant in helping you achieve that aim?		
					Complete waste of time	Neutral	Extremely useful
			<input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
			<input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
			<input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

15. WORKSHOPS, TRAINING PROGRAMS (including on-line and face-to face) or other support and activities (such as field days, and on-farm demonstrations).

Please tell us about various workshops/training programs or other support and activities you have participated in (or led) which have been focused on land-management issues over the last 5 years (6 Easy Steps, Smart Cane BMP or other such as produce boards e.g. Herbert Cane Productivity Services / Burdekin Productivity Services). If more than five (5), just tell us about the most recent ones.

Please tick if you have participated in more than five (5) during the last 5 years yes

Name of workshop/training program /activity	Year	How did you find out about it? (e.g. friend, google, extension officer)	What was the most important thing you hoped to achieve by doing this?	How useful was the training in helping you achieve that aim?		
				Complete waste of time	Neutral	Extremely useful
				<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
				<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Which of these workshops or training programs was the most useful and why?

16. What could be done to make grants, training programs, workshops and/or extension activities work better for you (i.e. to help you meet your own personal goals)

What extension support or training would you like in the future to help you make farm improvements?

The following sections will ask about motivations, satisfaction and reasons why you do things. The same statements will be given for three different practices. It may seem repetitive but we will really appreciate if you answer all of them.

Irrigation Practices

SKIP QUESTION IF NO IRRIGATED CROPS

We would like to know the reasons why you are doing specific agricultural practices or not doing them, what motivates you in these decisions and whose advice is most important to you (you will be asked to answer questions in Hectares or Acres, please only answer using one measurement)

17. Roughly, how much irrigated water do you use per hectare (acre) for your crops (e.g. ML per acre) each year?

_____ ML per hectare per year

_____ ML per acre per year

_____ I do not know

18. How much irrigation water do you estimate runs off the block? (Please tick)

SKIP QUESTION IF NO IRRIGATED CROPS

0-25%

25-50%

50-75%

75-100%

19. What irrigation scheduling tools do you use? (Please tick all that apply)

None

Soil moisture probes such as tensiometers and capacitance probes

Mini pans

Calculation of daily crop water use, using crop factors, class A pan, or crop model (e. g. WaterSense)



Other (please tell us which ones) _____

How long have you used those tools to schedule irrigation? _____ years

Do you plan to do this next year? (Please tick) No Yes (please tell us what you will do below)

If you plan to do something different, what is it? _____

20. Think about your current tools for scheduling irrigation and tell us how much you agree or disagree with each of the statements. **SKIP IF NO IRRIGATED CROPS**

	 Strongly disagree	Neutral	 Strongly agree	Do not know/ Not sure
The farmers I respect most do this	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Most farmers in this region would not have the technical knowledge to do this	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Most farmers in this region would not be able to afford to use this system for scheduling irrigation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Compared to other ways of scheduling irrigation, this is:				
The best way to meet my own personal goals (question 10)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The best way to maintain good cash-flow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The best way to reduce business risk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The least time-consuming (or labour intensive)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The most effective way of controlling nutrient loss from my property	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I only do this because I am forced to Who/what is forcing you? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The people/organisations whose advice I follow most think I should do this	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

21. Please tell us whose advice you follow most when scheduling irrigation (please rank the most relevant options. 1 = most important)

- ___ Family who are also cane farmers
- ___ Landcare
- ___ Other cane farmers
- ___ Researchers
- ___ Canegrowers (the organisation)
- ___ Industry extension advisors (e.g. from SRA [BSES], Productivity Services group)
- ___ Regional cane association (e.g. from Kalamia, Invicta, Inkerman, Tully)
- ___ People from NQ Dry Tropics/Terrain NRM
- ___ Other extension officers. From where? _____
- ___ Private Agronomists
- ___ People from government departments. Which departments? _____
- ___ Other. Who? _____

Calculating Fertiliser Application Rates

22. How many soil tests per 40 hectares of fallow or re-plant cane did you do last year?

_____ (insert number of soil tests)

Comments: _____

23. How do you calculate fertiliser application rates? (Please tick all that apply)

- I use industry standard rates for district yield potential, and use that amount on all parts of my farm
- I use more fertiliser on high – performing (high yielding) blocks
- I estimate amounts from my farm yield and use that amount on all parts of my farm
- My advisor does this for me
- I use more fertiliser on under-performing (low yield) blocks than on other blocks
- I tailor my fertiliser rates to different parts of the property
- Other. Please tell us what you do _____

How long have you used this system to calculate fertiliser application rates?



I have always done this

If you have not always done this, please tell us for how many years you have used this system _____(years)

Do you plan to do this next year? (Please tick) No Yes (please tell us what you plan to do)

If you plan to do something different, what is it?

24. Think about your current system for calculating fertiliser rates and tell us how much you agree or disagree with each of the statements.

	 Strongly disagree		Neutral		 Strongly agree	Do not know/ Not sure
The farmers I respect most do this	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Most farmers in this region would not have the technical knowledge to calculate fertiliser rates in this way	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Most farmers in this region would not be able to afford use this system for calculating fertiliser rates	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Compared to other ways of calculating fertiliser rates, this is						
The best way to meet my own personal goals (question 10)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The best way to maintain good cash-flow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The best way to reduce business risk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The least time-consuming (or labour intensive)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The most effective way of controlling nutrient loss from my property	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I only do this because I am forced to Who/what is forcing you? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The people/organisations whose advice I follow most think I should do this	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

25. Please tell us whose advice you follow most when it comes to calculating fertiliser application rates (please rank the most relevant options. 1 = most important)

- ___ Family who are also cane farmers
- ___ Landcare
- ___ Other cane farmers
- ___ Researchers
- ___ Canegrowers (the organisation)
- ___ Industry extension advisors (e.g. from SRA [BSES], Productivity Services group)
- ___ Regional cane association (e.g. from Kalamia, Invicta, Inkerman, Tully)
- ___ People from NQ Dry Tropics/Terrain NRM
- ___ Other extension officers. From where? _____
- ___ Private Agronomists
- ___ People from government departments. Which departments? _____
- ___ Other. Who? _____

Practices for handling run-off (you will be asked to answer questions in Hectares or Acres, please only answer using one measurement)

26. How do you handle run-off from rainfall or irrigation? (Please tick all that apply)



- I have recycle pits/sediment traps
- I do not capture run-off
- I have recycle pits or sediment traps and have adequate pumping capacity to recycle the water
- Other. Please tell us what you do _____

How long have you used this system to handle run-off? _____ years

Do you plan to do this next year? (Please tick) No Yes (please tell us what you plan to do)

If you plan to do something different, what is it?

27. Think about your current system for handling run-off (from rainfall and irrigation) and tell us how much you agree or disagree with each of the statements.

	 Strongly disagree	Neutral	 Strongly agree	Do not know/Not sure
The farmers I respect most do this	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Most farmers in this region would not have the technical knowledge to do this	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Most farmers in this region would not be able to afford to use this system for handling runoff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Compared to other ways of handling run-off, this system is:				
The best way to meet my own personal goals (question 10)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The best way to maintain good cash-flow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The best way to reduce business risk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The least time-consuming (or labour intensive)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The most effective way of controlling nutrient loss from my property	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I only do this because I am forced to Who/what is forcing you? _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The people/organisations whose advice I follow most think I should do this	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

28. Please tell us whose advice you follow most when it comes to handling run-off (from rainfall and irrigation) (please rank the most relevant options. 1 = most important)

- ___ Family who are also cane farmers
- ___ Landcare
- ___ Other cane farmers
- ___ Researchers
- ___ Canegrowers (the organisation)
- ___ Industry extension advisors (e.g. from SRA [BSES], Productivity Services group)
- ___ Regional cane association (e.g. from Kalamia, Invicta, Inkerman, Tully)
- ___ People from NQ Dry Tropics/Terrain NRM
- ___ Other extension officers. From where? _____
- ___ Private Agronomists
- ___ People from government departments. Which departments? _____
- ___ Other. Who? _____

29. Do you use any other innovative practices to reduce nitrogen and/or runoff? (Please tick)

- Yes (please tell us which practices you use below)
- No (skip to Q30)

If yes, which practices _____
 _____?

30. Please indicate if you agree or disagree with each statement below

	Strongly disagree		Neutral		Strongly agree		Do not know/ Not sure
Nutrient loss from my property has no impact on water quality in local streams, rivers & waterways	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

What are the top causes of poor water quality in your local streams, rivers & waterways?

- 1) _____
- 2) _____

Cane-growing plays almost no role in the declining health of the Great Barrier Reef	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
---	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

What are the top two pressures on the health of the Great Barrier Reef?

- 1) _____
- 2) _____

31. Roughly how many ML per hectare (acre) of water do you think most other cane growers in your region (not you personally) apply to their crops each year? **SKIP QUESTION IF NO IRRIGATED CROPS IN YOUR AREA**

_____ ML per hectare per year OR
_____ ML per acre per year

32. How many soil tests per 40 hectares of fallow or re-plant cane do you think that most other cane growers in your district (not you personally) did last year?

_____ (insert number of soil tests)

Comments: _____

33. Would you like to enter into the prize draw? We will need your email address to notify you of the winner (this information will not be shared)

Email address: _____

Just a little more background information about you. Background information about you and your farm will help us to identify and understand your priorities and farming style, which is essential for improvement of natural resource management.

34. What is your age group?

- | | | | |
|--|--|--|---|
| <input type="checkbox"/> 15 – 19 years | <input type="checkbox"/> 35 – 39 years | <input type="checkbox"/> 55 – 59 years | <input type="checkbox"/> 75 – 79 years |
| <input type="checkbox"/> 20 – 24 years | <input type="checkbox"/> 40 – 44 years | <input type="checkbox"/> 60 – 64 years | <input type="checkbox"/> 80 – 84 years |
| <input type="checkbox"/> 25 – 29 years | <input type="checkbox"/> 45 – 49 years | <input type="checkbox"/> 65 – 69 years | <input type="checkbox"/> 85 years and older |
| <input type="checkbox"/> 30 – 34 years | <input type="checkbox"/> 50 – 54 years | <input type="checkbox"/> 70 – 74 years | |

35. What is your gender? (Please tick) Male Female

36. What is your cultural heritage? (Please tick)

- Australian (Non-Indigenous)
- Aboriginal and/or Torres Strait Islander
- Italian
- Greek
- English
- Indian
- Other (Please specify) _____

37. Were you born in Australia? (Please tick) Yes No

38. What formal education do you have? (Please tick one)

- High school (year 10)
- Trade / apprenticeship
- TAFE
- University
- High school (year 12)
- Agricultural college
- Other (please specify) _____

39. What is your marital status? (Please tick one)

- Single
- Married or De-facto relationship
- Divorced
- Widowed

OPTIONAL QUESTIONS

Combined with demographic factors and characteristics of the farm this type of information will really help us to understand your situation better. It will really help us to deeper understand your reasons for adopting or not adopting practices associated with water quality improvement.

Remember this information is kept private.

40. Averaged out over good and bad years, roughly what cane yield per hectare (per acre) do you achieve on your property?

- | | | |
|--|--|---|
| <input type="checkbox"/> 0-20 t/ha (0-8.1 ton/ac) | <input type="checkbox"/> 20-40 ton/ha (8.1-16.2 ton/ac) | <input type="checkbox"/> 40-60 ton/ha (16.2-24.3 ton/ac) |
| <input type="checkbox"/> 60-80 ton/ha (24.3-32.4 ton/ac) | <input type="checkbox"/> 80-100 ton/ha (32.4-40.5 ton/ac) | <input type="checkbox"/> 100-120 ton/ha (40.5-48.6ton/ac) |
| <input type="checkbox"/> 120-140 ton/ha (48.6-56.6 ton/ac) | <input type="checkbox"/> 140-160 ton/ha (56.6-64.7 ton/ac) | <input type="checkbox"/> 160-180 ton/ha (64.7-72.8 ton/ac) |
| <input type="checkbox"/> 180-200 ton/ha (72.8-80.9 ton/ac) | <input type="checkbox"/> 200-220 ton/ha (80.9-89 ton/ac) | <input type="checkbox"/> More than 220 ton/ha (more than 89 ton/ac) |

41. Roughly, what was the NET income earned from this property last year (after all costs and taxes were taken out)? _____

Is this before or after you have paid yourself (and other family members who help on the property) wages/salary?

- Before paying myself and family
- After paying myself and family



THANK YOU

We know that your time is valuable. In recognition of this, by completing this survey you can go into the draw to win a Drone worth \$1500 or equivalent value in cash or a travel voucher.

DID YOU PROVIDE YOUR EMAIL ADDRESS?



<http://store.dji.com/product/mavic-pro>

What's in the box:

- DJI Mavic Pro
- Remote Controller
- DJI Intelligent Flight Battery for Mavic Quadcopter
- 3 x 8330 Quick-Release Folding Propellers
- Charger
- AC Power Cable for Charger
- 16GB microSD Card
- Micro-USB Cable
- RC Cable with Lightning Connector
- RC Cable with Micro-USB Connector
- 2 x RC Cable Slider
- Mavic Pro Quick Start Guide and Manual
- Mavic Pro Disclaimer and Safety Guidelines
- Mavic Pro Intelligent Battery Safety Guidelines
- 1 year warranty



The Mavic from DJI packs features you once thought possible only on much larger platforms into a compact quadcopter that is snappy, agile, and captures high-resolution images. The drone features an advanced flight control system that draws on a host of sensors — including a ground-facing camera, ultrasound, GPS, dual redundant IMUs, and more — to keep track of where it is flying in 3D space and even avoid collisions. The Mavic works in tandem with DJI's GO mobile app for accessing settings, getting a telemetry readout, viewing a low-latency video feed, and even editing and sharing your footage. In addition traditional joystick style controls, you can fly with simple tap-based commands, and the Mavic can even recognize gestures for the perfect selfie.

This project is supported through funding from the Australian Government's National Environmental Science Programme



www.nesptropical.edu.au