The barriers to adoption of recommended fertiliser use practices by sugarcane growers in the Wet Tropics

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Declaration on Ethics

The research presented and reported in this thesis was conducted within the guidelines for research ethics as outlined in the National Statement of Ethical Conduct in Research Involving Humans (1999) and the James cook University Australia Statement and Guidelines on Research Practice (2001). The proposed research methodology received clearance from the James cook Ethics Review Committee (approval number H2403) on 28 June 2006. The final report was submitted on 16 February 2011.

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Acknowledgements

I began this journey as an experienced and mature environmental scientist with a great deal of certainty about science and a specific knowledge goal in mind. My knowledge and thinking have been challenged and I initially resisted delving into the knowledge/power relations that underpin this study. I am no longer the same person. I have changed the way I perceive environmental problems and observe new ways for resolving them.

Many people have journeyed with me on my quest to understand and explain what was driving growers' resistance to a particular recommended environmental practice. I must firstly thank the participants who agreed to be interviewed for this study and who gave freely of their time and were willing to speak candidly about their views. Without them this study could not have taken place. Tom Watters' was the first cane grower I met in Cairns when I worked as a water quality officer for the EPA. Seeing Tom's efforts and enthusiasm for sustainable farming created a pivotal moment in leading me to this study.

I would like to thank my long-serving supervisor Dr. Janice Elder for providing positive supervision and support and introducing me to challenging environmental sociological theory. I would also like to thank her for continuing to supervise me after she moved interstate and suffered the loss of her newly finished home in the 'Black Saturday' Victorian bushfires of 2009. I extend my thanks also to Dr. Peter Thorburn of the CSIRO who supported my bid for a SRDC scholarship and also provided valuable supervisory guidance. I have enormous respect for Peter's knowledge, wisdom and generosity of spirit. Thanks also to Dr. Emma Jakku of the CSIRO who also provided supervisory guidance and support during my candidature. I am deeply indebted to Dr. Lisa Law who kindly took on the primary supervisor role in the last crucial stages of my candidature. Without Lisa's excellent critical feedback, guidance and kindness I could not have completed this thesis. Thanks also to Dr. Paul Nelson who as co-supervisor so generously shared ideas and experiences and encouraged me when I had moments of self-doubt.

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Contribution of Authors on the Co-Authored Paper

I hereby declare that the published co-authored paper, which forms the basis of Chapter Five, was written mostly by myself. Editorial contributions by other authors comprise fifteen per cent by Dr Janice Elder, ten percent by Dr Peter Thorburn and five percent by Dr Emma Jakku. For this thesis I have removed the abstract and modified the introduction and conclusion sections.

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Abstract

The dominant scientific paradigm holds sugarcane growers' cultivation practices responsible for the greatest amount of soil and nutrient run-off flowing from the Wet Tropics coast to the Great Barrier Reef (GBR) lagoon. Despite strong encouragement from governmental agencies, coupled with proposed gains from reduced costs and increased levels of sugar content after reducing fertiliser use, sugarcane growers have been reluctant to alter their fertiliser practices – a situation that has puzzled Reef protection scientists. This study originally set out to understand grower's reluctance, and involved eighty-two in-depth interviews with sugar industry representatives (growers, mill agents) from two case study areas in the Wet Tropics region and other stakeholders with interests in the industry's environmental performance (scientists, policy makers). This qualitative methodology was used to interrogate participants' values, interests and beliefs, which in turn motivated their actions and views regarding fertiliser usage.

Ecological Modernisation Theory (EMT) provided the initial conceptual framing for understanding the way different sectors of the sugar industry responded to the recommended environmental practice. Yet through this EMT lens important economic, social and environmental issues emerged that suggested that the proposed benefits of the science and technology offered to the sugar industry were fraught with problems. Moreover, knowledge disputes about the validity and contested nature of the dominant science became an important component of the analysis – especially as these highlighted the power relations of different stakeholders. Foucault's notion of the knowledge/power nexus and associated debates about eco-governmentality provided an additional conceptual framing of the sugar industry and its governance. The combined EMT and Foucauldian analysis of sugarcane growers' reasons for not reducing fertiliser use provided insights into the problems associated with the reliance urban bureaucrats place on scientific expertise to inform natural resource management (NRM) policy without consulting local rural peoples' knowledge.

Effective, acceptable and sustainable environmental policy relies on well-briefed policy makers who can account for the validity and potential social and economic impacts of their policies. This study's method of investigation could contribute to better ways of working with farmers on issues of environmental management. Granting more credence and respect for rural people's knowledge will lead to more sustainable NRM policy development outcomes through a more democratic process of making decisions that ultimately affect the livelihoods of those farmers.

Publications

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Conference Papers and Presentations

Benn, K. (2009) *Protecting the Great Barrier Reef and Wet Tropical Coast landscape through the Ecological Modernisation of the sugarcane industry*, Reinventing the Rural Between the Social and the Natural, XXIII ESRS Congress Vaasa, Finland, 17-21 August 2009.

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Benn, K. (2007) *The structural and cultural influences of the Queensland sugar industry that affect its ecological sustainability*, Environmental Research Event: 2007 Proceedings and Program, Global Problems – Local Solutions, 2-5 December, James Cook University, Cairns.

Preface

As one of Australia's first graduates in environmental science I commenced my career as a secondary school teacher and became the Vice President of the Victorian Association of Environmental Education and the Victorian State Delegate for the Australian Association of Environmental Education. I then decided that the place to make a real difference for the environment was in policy development. Prior to undertaking this study I had spent sixteen years working as an environmental scientist, planner and policy developer for a range of government agencies and a Green Non-Government Organisation. These agencies included Greening Australia Victoria, Department of Agriculture Victoria, Environmental Protection Authority NSW, Curriculum Corporation (a publishing organisation), Melbourne Water Corporation (Sewerage Sector) and the Queensland Environmental Protection Agency (QEPA). My main areas of expertise are natural resource management and in particular water quality management. In my last position with QEPA I co-developed the Wet Tropical Coast Regional Management Plan. My colleagues (who became my friends) from Great Barrier Reef Marine Park Authority (GBRMPA), the Australian Institute of Marine Science (AIMS), Australian Centre for Tropical Freshwater Research (ACTFR) and Commonwealth Scientific and Industrial Research Organisation (CSIRO) and I spent many years working to protect the water quality flowing from the land to the Great Barrier Reef. In particular we focused on run-off of sediments and nutrients from agricultural activities.

The purpose of this preface is to set the scene of my background, values and beliefs prior to undertaking this study. It was never my intention or desire to undermine the work of scientists in general or of my colleagues. The undertaking this study took me on a long journey that opened my mind to another set of perspectives regarding natural resource management, and in particular, more effective ways of working with farmers to achieve sustainable development policy outcomes that deliver a win-win for all concerned. I hope that this study will make a contribution to that objective.

Abbreviations

ACF	Australian Conservation Foundation
ACTFR	Australian Centre for Tropical Freshwater Research
AIMS	Australian Institute of Marine Science
AMCS	Australian Marine Conservation Society
BATNEEC	Best Available Techniques Not Entailing Extensive Costs
BMP	Best Management Practice
BPM	Best Practicable Means
CCS	Commercial Content of Sugar
CFC	Chlorofluorocarbon
COMPASS	Combining Profitability and Sustainability in Sugar
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSR (Sugar)	Colonial Sugar Refinery (operates mostly Queensland mills and refineries, while Sugar Australia operates refineries in Melbourne, Mackay and Auckland)
DAFF	Department of Agriculture, Fisheries and Forestry
DEHP	Department of Environment and Heritage Protection
DNRE	Department of Natural Resources and Energy
EP Act	Environmental Protection Act
EPA	Environmental Protection Agency (Queensland), now DEHP
EMP	Environmental Management Plan
EMS	Environmental Management System
EMT	Ecological Modernisation Theory
ESD	Ecologically Sustainable Development
ESRC	Economic and Social Research Council
FRG	Federal Republic of Germany
GBR	Great Barrier Reef
GBRMPA	Great Barrier Reef Marine Park Authority
GCTB	Green Cane Trash Blanketing
GEC	Global Environmental Council
GDP	Gross Domestic Product
GNP	Gross National Product
GVP	Gross Value of Production
ICSU	International Council of Scientific Unions

IGBP	International Geosphere Biosphere Project
IMI	International Meteorological Institute
IPC	Integrated Pollution Control
IPCC	International Panel on Climate Change
JCU	James Cook University
LPK	Local People's Knowledge
MTSRF	Marine and Tropical Sciences Research Facility
NASA	National Aeronautics and Space Administration
NGO	Non-Governmental Organisation
NRMB	Natural Resource Management Board
OES	U.S. Bureau of Oceans International and Environmental and Scientific Affairs
R&D	Research and Development
RPK	Rural People's Knowledge
SILO	Sugar Industry Liaison Officer
SRDC	Sugar Research and Development Corporation
STEPS	Social, Technological and Environmental Pathways to Sustainability (organisation based at University of Sussex, U.K.)
STP	Sewage Treatment Plant
TWS	The Wilderness Society
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
WHA	World Heritage Area
WMO	World Meteorological Organisation
WQIP	Water Quality Improvement Plan
WRI	World Resources Institute
WWF	World Wide Fund for Nature

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Chapter 1 Introduction

1.1 Impetus for this study

On a sunny Friday afternoon late in the dry season, I was on my way to Mossman to attend a shed meeting[1]. It was the sugarcane harvest season, known locally as 'the crush', and this was the least busy and therefore best time of year for growers and extension officers to meet for agronomic discussions. A small group of local growers met to be briefed about the latest trends in fertiliser use efficiency trials in their area by their local industry extension officers. It was then my turn to speak. Representing the Environmental Protection Agency (EPA) as its Sugar Industry Liaison Officer, I told them about a grant scheme designed to fund actions that would help to reduce the run-off of sediments and nutrients to receiving waters and the Great Barrier Reef (GBR). I was conscious that I was 'from the government' and in particular their least favourite government department. I was careful to prepare how I came across and made an effort to avoid looking like an office bound bureaucrat (I dressed in jeans, a chambray shirt, work boots and an Akubra hat[2]) and made every effort to ensure I did not talk down to them. I encouraged growers to consider this scheme as an opportunity to be funded for a project that could fix a problem on their land, or create savings in fertiliser costs, while delivering desired governmental water quality outcomes. After some discussion I detected some reluctance from many of the growers and asked them to talk it over with the extension officers I was collaborating with on the project. We then finished the formal part of the meeting and gathered around the barbeque for informal and social discussions. It was then that one of the growers said something that struck a chord and became the seed that later germinated into this study. The grower had said "we just do what the mills tell us to". Until that moment, I had not considered the extent to which mills might affect growers' cultivation practices.

Were the growers reluctant to adopt the recommended practices being recalcitrant and ignorant? Could it be that the mills played a bigger role in growers' cultivation practices than was apparent to government Natural Resource Management (NRM) policy staff and research scientists? Perhaps growers were not at liberty to make unencumbered decisions about their cultivation practices. Were there legitimate reasons why growers did not adopt certain practices? These questions sprang to mind and initiated this study about the underlying drivers for the resistance of Wet Tropics sugarcane growers to the adoption of recommended reduced rates of fertiliser use.

[1] A 'shed meeting' is a colloquial term for a gathering of growers, held by an extension officer at one of the local growers' properties, in their shed. It is a forum for discussing agronomic advances and issues.
[2] A traditional Australian brand of hats designed initially for cattlemen and farmers.

Research undertaken for this study indicates there is a mismatch between environmental policy recommendations and grower practices, and this knowledge gap will be outlined in the following sections. Research stresses that NRM policy makers need to be well briefed in the social and economic impacts of a proposed policy for it to be effective and acceptable. In other words, sustainable development policy tends to work best when it achieves positive economic and social outcomes as well as environmental ones. Bureaucrats rely on scientific expertise to inform NRM policy, and scientists usually describe and measure environmental risks and suggest how risks should be managed. Although elected politicians make the final political decisions after fielding pressure from industry and green lobbyists, they still rely heavily on advice from the bureaucrats who develop policy in consultation with experts and scientists. Yet bureaucrats and scientists are often removed from the regional people affected by their policies and this can lead to policy failures. This research teases out some of these problematic networks of knowledge and power.

1.2 The environmental issue

The highly politicised nature of the alleged damage to coastal waterways and the GBR from agricultural run-off motivated this research. Scientists had reported their findings and concerns since the 1970s. During the 1980s the media picked up on the issue and television programs[3] were screened showing plumes of sediment and nutrient run-off. This run-off was alleged to be polluting the GBR and emanating from coastal farming activities (Brodie, 1996; Brodie and Furnas, 1996; Brodie *et al.*, 2007)). Media attention prompted concerns from Green Non-Government Organisations (NGOs) and also upset people working in agricultural industries along the coast. Once the issue had gained wider media attention it then came under the jurisdiction of bureaucrats and policy makers. Because sugarcane cultivation was the dominant agricultural industry along the Wet Tropical Coast[4] growers were then held responsible for causing the greatest amount of soil and nutrient run-off flowing to the GBR.

Another issue of particular concern for stakeholders involved in the protection of the GBR was that farming activities had been exempted from the *Environmental Protection Act, 1994* and therefore were not subject to legislative controls. Consequently, many governmental scientists, researchers and government agency staff (like myself) were employed to find ways to try to manage this problem through the development of policy tools rather than legislative means.

[3] The Australian Broadcasting Commission program *Four Corners* had screened its first story about run-off threatening he health of the GBR during the 1980s (Personal Communication from Government Reef Scientist (31) participant in this study).
[4] The Wet Tropical Coast extends from the Bloomfield River north of Cairns down to Wongaling Creek in Mission Beach and is known for its high environmental value. It is adjacent to the Great Barrier Reef.

Despite results from the field trials and simulations, and the potential savings from using less fertiliser, most of the growers were reluctant to change their current fertiliser practices. Instead they were sceptical of the field trial results and the scientists who conducted them. As a result, scientists, bureaucrats and many people outside of the sugar industry took the view that the growers who did not adopt the recommended practices were ignorant or recalcitrant. The well-publicised risk of soil and water degradation from fertiliser pollution, combined with the development of draft water quality targets for rivers draining into the GBR lagoon, had begun to stimulate a growing advocacy for government regulation of fertiliser application management in the sugar industry.

1.3 Conceptual propositions of the thesis

At the onset of this research I turned to Rogers' *Diffusion of Innovations* theory (Rogers, 1962, 1995) for a conceptual framework for understanding the machinations of adoption. Rogers' theoretical concepts have served as the source of the most authoritative scholars' work on the motivators and barriers for adoption of a new product or innovation. A large amount of literature already exists on farmer (and grower) adoption studied through the lens of Rogers' theory, with the following authors' publications representing a small sample: Barr and Cary, (1984, 1992, 2000), Bartley and Connell (1991), Carr (1997), Cary, Webb and Barr (2002), Chamala (1987), Dibden and Cheshire (2005), Frank (1997), Grasby *et al*., (2000), Guerin and Guerin (1994, 2000), Kraak (2000), Lawrence, Lyons and Momtaz (1996), Vanclay (1992, 1997) and Vanclay and Lawrence (1994). There are many predictable factors found to influence the adoption of innovations and these often include: innovation costs, commodity prices and the trialability and perceived usefulness of the innovation; the age, gender, ethnicity and level of education of farmers; the size of the farm and farm income; and the relative advantage and complexity of the innovation. Much of the literature on farmer adoption that was framed by Rogers' theories implied freedom for farmers to make decisions about environmental practices. The literature also tended to assume that particular innovations were beneficial for farmers (Buttel *et al.*, 1990). There was only a very small discussion that questioned the benefits for farmers in the adoption of reduced fertiliser application rates or the need for the innovation in the first place (Carter, 2006; Choukroun *et al*., 2010; Larcombe, *et al.*, 1995. Larcombe and Woolfe, 1999; Larcombe, *et al*., 1996).

This study commenced with the proposition that the mills might be influencing growers' freedom to make decisions about their cultivation practices. The sugarcane industry is unique in its structure in that each region is defined by the location of the sugar mill and growers send

their entire crop to their (one) local mill. Each mill is the only buyer of the harvested sugarcane within that mill region. Mills, as the only buyers, therefore exert considerable influence on growers with regard to product (crop) preferences. Mill staff traditionally make explicit (to growers) which crop features they are looking for in the sugarcane they receive. The mills cannot exist without the growers, and likewise, the growers depend on the mills and need to meet their requirements. Despite this interdependency there are many NRM policy makers who target the growers almost exclusively and have overlooked this important relationship. The mill-grower relationship is complex, with conflicting and competitive elements as well as examples of strong alliances (Antony, 2004; Hungerford, 1996). It therefore warrants deeper examination and understanding.

Because growers' cultivation practices are affected by mill preferences, Rogers' theory did not provide the appropriate lens to contribute new insights into the barriers to recommended environmental practices in the Australian sugar industry. Instead, a theoretical framework that could examine the role and effect of mills on grower adoption decisions, from within a more eco-industrial context, was required. Ecological Modernisation Theory (EMT) provided the early conceptual framing of how different sectors of the industry responded to recommended environmental practices. In other words, it was a conceptual framework that could analyse the industrial components within the broader political arena that influences an industry's ecological performance. EMT elevated the focus of the inquiry from a grower-centric study to a whole of industry study. An EMT analysis also provided an alternative and novel way of viewing growers' barriers to innovations in fertiliser application.

EMT presents a way of developing environmental policy that supports the progressive transformation of the institutions in modern societies to achieve ecological industrial reform. Science and technology provide the tools for ecological reconstruction and EMT provides a model for thinking about how government can provide market incentives and ways that Green NGOs can work effectively with industry to facilitate the adoption of ecological innovations (Huber, 1982, 1985; Mol and Spaargaren, 1998). The four core features of EMT identified by Mol (1999) are: advances in science and technology; economic and market dynamics that stimulate innovation; state intervention instruments; and pressure from environmental NGOs. Looking through an EMT lens provides another way of viewing the proposed benefits of the science and technology offered to the sugar industry were fraught with problems. Many growers remain unconvinced by both the science and scientists who advocate that the over-use of fertilisers is responsible for polluting the GBR. Forced reductions in fertiliser use are viewed by growers as a very serious risk to their incomes, when the payment system is based on the

volume of cane sent to the mill. Further reductions in the volume of sugarcane sent to the mills are also perceived by mills as a threat to their sustainability, especially when the number of sugarcane growers has also been declining. Unlike an EMT model for stimulating ecological reform through economic and market dynamics, the government's proposal to resort to legislative measures for regulating fertiliser resembles a hierarchical model of command-and-control measures that are less effective in achieving sustainable outcomes. In addition, Green NGOs may be missing an opportunity to work more closely with industry, in a non-adversarial approach, to better understand the industry's needs and concerns and their reasons for resistance.

When examples of knowledge disputes arise between growers and experts/scientists an adversarial approach often results in winners and losers. Other approaches were explored in this study to find better ways of achieving sustainable outcomes for industry and the environment and this entailed a deeper investigation of the knowledge and information that the policy recommendations were based on. The word of revered experts is rarely questioned in modern society, where we depend so heavily on their highly valued expertise. On the other hand, many farmers believe their knowledge is readily dismissed. This study thus raised questions about the validity and contested nature of the dominant science underpinning policy measures.

When the research commenced I treated scientific claims as factual or 'true' and had no reason to question the validity of the science. A water quality scientist like myself usually accepts the dominant view held and propagated by scientists from respected institutions (whom I often consulted on these matters). I had, in the early stages of the research, imagined an analysis through the lens of EMT as providing adequate insights into the complexity of the industrial structure and culture affecting grower adoption. Yet as the study progressed, the power relations between various stakeholders with interests in Wet Tropics sugarcane cultivation methods became impossible to ignore. These power imbalances were productive and played an important role in shaping policy developed for NRM purposes. Indeed, the ways in which participants' perspectives and worldviews were affecting environmental policy development called for a different kind of understanding. Foucault's notion of the knowledge/power nexus, and associated debates about ecogovernmentality[5], helped frame a different way of understanding the sugar industry and its regulation/governance. Foucault was interested in the relations between power, knowledge and discourse and his research examined how knowledge production was intertwined with structures of power. For Foucault, it is through the naming,

[5] An expansion of Foucault's concepts on 'the art of government' into ways of knowing and mediating through new environmentally focused institutions that have had an ecologically neo-liberalising effect on government, causing the growing phenomenon of ecogovernmentality (Goldman, 2001).

classification and regulation of identities and practices that power is executed (whether this is in schools, prisons, hospitals). In this study, environmental scientists/experts form part of this nexus in their naming, describing, defining and assessing the environment and environmental problems. As will be discussed in more detail throughout this study, their interests become integrated with the state.

Scholars working in the field of ecogovernmentality examine how the state (or government) works together with 'experts' to construct 'the environment', and how this knowledge becomes part of the rational logic and technology of the state (or a form of governmentality[6]) (see Darier, 1995; Fairhead and Leach, 2000, 2003a, 2003b; Goldman, 2001; Luke, 1995a, 1995b, 1996, 1999; Rutherford, 2007). In this tradition, the environment is described and defined by experts/scientists who then describe and define risks, problems, issues and crises in the environment that they deem in need of management and policy intervention. These same experts are then consulted for their advice on *how* to manage the environmental problems. An interpretation through this conceptual framing enables insight into how the regulation of sugar cane growing in the Wet Tropics, affects growers' practices.

1.4 Research questions and thesis structure

The question that initially drove this research was:

- *What were the underlying barriers to adoption of recommended fertiliser practices by sugarcane growers in the Wet Tropics?*

This question then gave rise to the more questions as the study progressed:

- *Did the mills play an important role in influencing growers' cultivation practices?*
- *What economic, social and environmental factors influenced growers' adoption of their cultivation practices?*
- *Why do growers not adopt certain recommended practices?*

[6] Foucault's use of the term 'governmentality' was designed to draw attention to reflections on the power-knowledge processes and apparatuses through which populations are governed rather than a view limited to aspects of government such as the body of state ministers or even to the state itself (Rose and Miller, 1992; Scott and Marshall, 2005).

- *What constitutes effective sustainable development policy?*

Examining these evolving questions provided the basis on which to draw out grower knowledge that had not been considered in bureaucratic circles, and to further examine the relationship between the sugar industry and those involved in developing environmental policy affecting it.

In Chapter Two, an examination of the history, culture, structure and regulation of the sugar industry reveals the complex interdependent relationship between growers and mills and how this relationship has shaped growers' cultivation practices. The mill, as the sole buyer of harvested sugarcane in each locality, does have a significant influence on growers' practices. But the extent of a mill's influence is not the only reason for growers' adoption or non-adoption of a practice and this becomes evident in later chapters.

Chapter Three encompasses two quite different realms of theory that have not been used together before in a study of farmer adoption in Australia. The first, EMT, has been used as a lens to understand the industry's capacity to adopt recommended environmental practices. Foucault's theoretical concepts provided an alternate lens, however, and help interrogate discourses that inform how an environmental problem can be perceived and managed. Chapter Four details the research methods used for the thesis and the emergent themes used to identify participants' perceptions and the dominant knowledges that influence policy development concerning the sugar industry.

Chapters Five and Six present perceptions on non-adoption through the lens of an EMT type of policy analysis. These chapters points to flaws in the recommended fertiliser practice and the science it is based on, and serious economic flaws that overlook the failure of proposed government policy to meet sustainable development objectives.

Chapter Seven critically interrogates the deep-seated reasons for non-adoption that centre on the differing values and beliefs of the two main groups of participants – the Industry Participants and the Reef Protection Participants – and how their opposing perceptions fuel mistrust. Chapter Eight then delves into the ways that these differing values and beliefs support different sets of knowledges, which then vary in access to power and influence over the governance of the GBR. The analysis reveals supplementary reasons why growers' resisted adoption of the recommended practices and why government turned to legislative measures to enforce them. The most contentious and controversial theme arising in Chapter Eight is the theme of Science,

Technology and Expert Advice, which reviews the science used to validate each set of opposing views.

Chapter Nine synthesises the reasons for non-adoption by growers that emerged throughout the study. Mills played an important role in influencing growers' choices of cultivation practices as they were the only buyers of harvested sugarcane and the payment system is entirely dependent on the volume of sugar produced, which is correlated to the amount of fertiliser used to grow the sugarcane. Underpinning the eventual enforcement of policy to regulate fertiliser usage was the knowledge shaped by the values and beliefs of the scientists, experts and bureaucrats who developed the policy. In contrast the sugar industry's knowledge was subjugated and thus disempowered growers.

Chapter 2 Development of the sugar industry and its impact on the landscape of the Wet Tropical Coast

2.1 Introduction

This chapter[7] explores ways in which the history and evolution of the sugar industry have influenced growers' choices of farming practices they consider to be suitable or unsuitable for sustaining their farming enterprises and protecting the health of the Great Barrier Reef. The declining health of the Great Barrier Reef in the Wet Tropics region has been attributed to nutrient run-off from agricultural activities on the coastal plain, upon which sugarcane cultivation is the most extensive land use. Consequently, sugarcane growers have been the main target for a plethora of policies, plans and strategies to encourage them to change their cultivation practices. There is an extensive body of literature about the reasons why Australian farmers have chosen to adopt or not adopt recommended practices (Barr, 1994, 2004, 2005; Barr and Cary, 1984, 1992, 2000; Buttel *et al*., 1990; Cary *et al*., 2002; Chamala, 1987; Frank, 1997; Frank and Chamala, 1992; Guerin and Guerin, 1994; Kraack, 2000; Lawrence *et al.*, 1996; Pannell *et al*., 2006; Vanclay, 1992, 1997, 1999). The most cited reasons why many farmers do not adopt some of the recommended environmental practices include lack of funds, time, expertise or other resources. Conversely, a key reason given for farmers adopting these practices is consumer pressure for 'cleaner and greener' farming practices (Barr and Cary, 2000; Cary *et al*., 2002; Vanclay, 1992; Vanclay and Lawrence, 1994). However, Australian sugarcane growers do not fit neatly into either of these 'adoption' categories, nor are they necessarily free to choose their farming practices without hindrance from within their industry, as is often assumed in much of the literature. A history of strong regulation and the close interdependence between sugarcane growing and milling (Antony, 2004; Antony *et al*., 2005; Archer *et al*., 2009) shows that growers are not freely able to make decisions about their cultivation practices. Furthermore, there is currently no market for 'clean and green' sugar. Thus the methods used to influence growers' cultivation practices, based on adoption theory (Rogers, 1962, 1995), are not effective in altering growers' cultivation practices in ways recommended to protect quality of water flowing to the GBR.

In this chapter, reasons why sugarcane growers do not readily adopt some recommended environmental practices are gleaned from the literature, along with an examination of the role that government policies play in affecting the adoption of these practices. First a description of

[7] This chapter is adapted from an article written by Benn *et al*., 2010. A copy of the article is included in Appendix 1.

the historical and current Wet Tropics landscape is required for an appreciation of the threats to its natural, social and economic values.

2.2 Background of Competing Interests

The Wet Tropics region in Far North Queensland is internationally famous for its landscape and natural heritage values (Weston and Goosem, 2004), being the only place in the world with two adjacent World Heritage Areas (WHAs): the Wet Tropics Rainforest WHA and the Great Barrier Reef WHA (Figure 1). The endemic fauna and flora values for this region are still extremely high. The Wet Tropics possesses 38 per cent of Australia's terrestrial vertebrate fauna; Australia's richest overall invertebrate fauna; 26 per cent of Australia's vascular plant diversity and 41 per cent of all Queensland's vascular plant species, all in slightly over one per cent of the State's land area (Weston and Goosem, 2004). These rainforests also provide an unparalleled living record of the ecological and evolutionary processes that shaped the flora and fauna of Australia over the past 415 million years (Weston and Goosem, 2004). The Wet Tropics of far north Queensland is considered to be a biodiversity 'hotspot' of global importance and labelled as 'Australia's biological crown jewels' (Weston and Goosem, 2004).

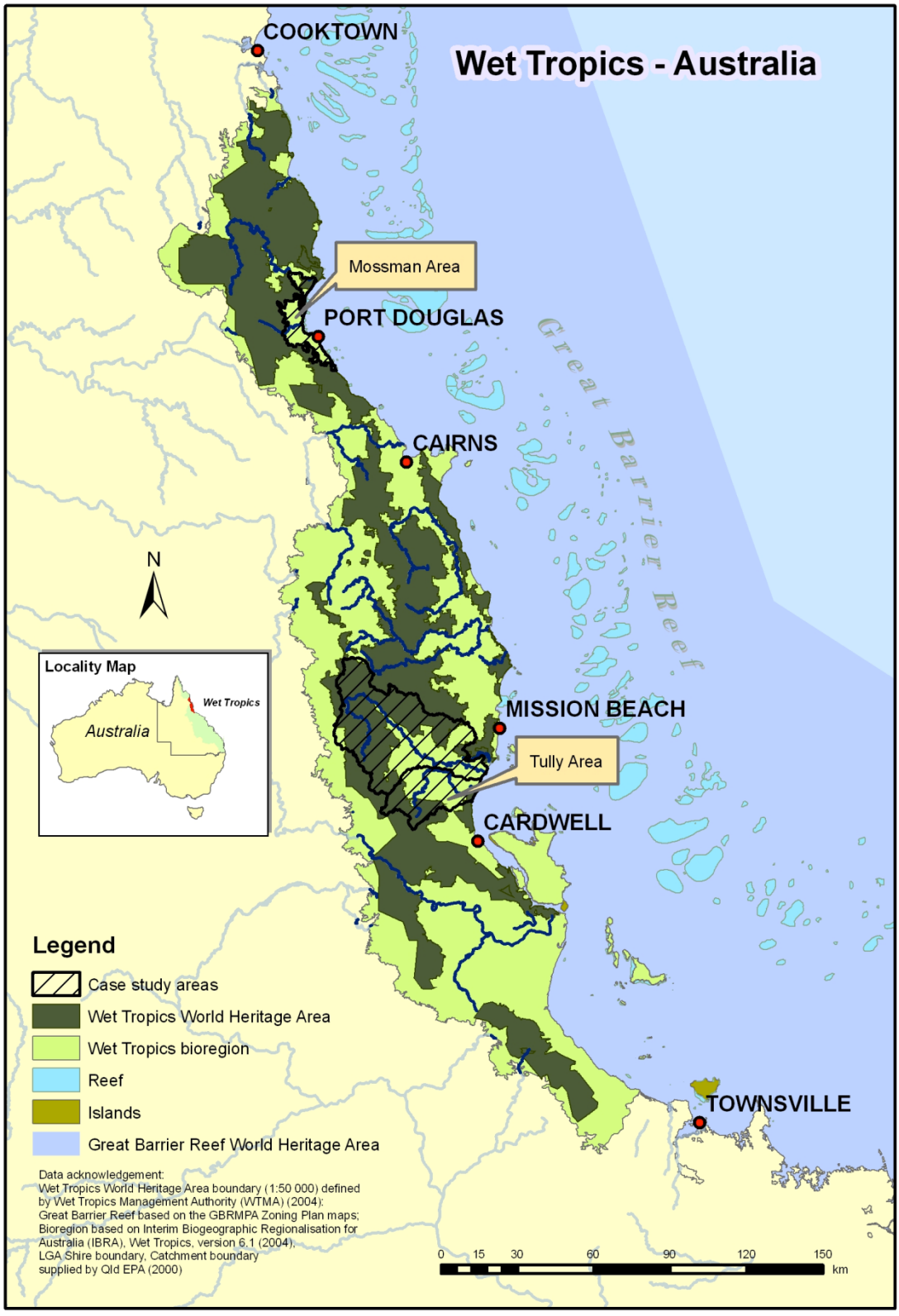

Figure 2.1 The location of Mossman and Tully on the Wet Tropics Coast of North Queensland

The mountain range that includes Queensland's two highest mountains (Mount Bartle Frere is 1622m and Mt. Bellenden Ker is 1593m) and runs parallel to the tropical coastline, gives rise to the elevated rainfall levels and associated vegetation of this region. The Wet Tropics landscape consists of rainforest vegetation on the hills and slopes of the coastal mountain range, with a myriad of rivers, creeks and gullies fanning out on to the coastal plains. The woodlands, wetlands and swampy vegetation that once dominated the coastal plains in the area between the foothills of the mountain ranges and the seashore have been replaced almost entirely by fields of sugarcane crops, with little of the original vegetation remaining (Wilson *et al*., 2002). By 1999, of the ten broad pre-clearing vegetation groups of the Wet Tropics region, there remained only 14 per cent of the wetland vegetation; 15 per cent of the low open woodlands (*E. leucophloia*); 46 per cent of the riparian eucalypt woodland; and 53 per cent of the eucalypt open forest (Wilson, *et al*., 2002). Clearing of vegetation for urban and agricultural activities had made a significant impact on the coastal landscape.

The Wet Tropics regional economy depends heavily on the tourism generated by these two WHAs. Income directly from tourism into this region, has contributed approximately 40 per cent of the gross domestic product (GDP) while the income from agriculture contributed approximately eight per cent to the region's GDP (Queensland Environmental Protection Agency, 2003). The Wet Tropics rainforest and the Great Barrier Reef WHAs have regularly attracted around two million visitors each year to the relatively small City of Cairns with its 130,000 residents (Guppy, 2008; Queensland Environmental Protection Agency, 2003). Tourism industry businesses expressed concern about the effects that farming activities were having on the Reef. The national Green movement and members of the tourism industry lobbied for the protection of the Reef's health since the 1980s. Finally, in the late 1990s and in 2003, State and Federal governments responded by developing policies and plans to protect the GBR. Meanwhile, the run-off issues had continued seemingly unabated.

In parallel to the protection of the natural values of the Wet Tropics region is the imperative to sustain the economic values and use of the region's natural resources. The sugar industry remains the dominant agricultural industry along the coastline adjacent to the GBR. The Australian sugar industry produces raw and refined sugar from sugarcane grown on more than 4,000 farms (Canegrowers, 2010). In 2006, the sugar industry directly employed some 22,000 people and about 110,000 in 'upstream' and 'downstream' economic sectors dependent on the industry (National Farmers' Federation, 2012). Australia is the third largest raw sugar supplier in the world, exporting 80 per cent of the sugar produced. In 2009-2010 the national production of sugarcane for crushing was 31.235 million tonnes, with Queensland's share of production

amounting to 29.330 million tonnes (National Farmers' Federation, 2012; Canegrowers, 2010). The value of production can vary from A$1.5 – A$2.5 billion each year (Canegrowers, 2010); in 2010-2011 Australian sugar exports were worth A$2.366 billion (National Farmers' Federation, 2012). Queensland accounts for about 90 per cent of raw sugar production, while New South Wales produces around 10 per cent and supplies the bulk of the domestic demand (National Farmers' Federation, 2012). The only buyers of harvested sugarcane are the regional mills, and they have no interest in producing 'cleaner and greener' sugarcane because there is no such demand from the buyers of the raw and refined sugar. Processed foods do not identify where the sugar has come from or how it was grown and consumers have demonstrated little or no concerns about these factors. This has left the Australian government (and the sugar industry) with an environmental dilemma.

The dilemma exists because the grower is paid for a crop of sugarcane according to both the tonnage and the sugar content and both of these factors are greatly affected by the available nutrient to the plant. As a natural monopsony[8], mills have a significant influence on growers' cultivation methods in their quest for maximum tonnage with the highest sugar content. Growers feel compelled to apply 'enough' or extra fertiliser as an insurance measure. There is no reward paid to growers for using less fertiliser, other than achieving a saving in investment costs (Keating *et al*., 1997). In fact, growers fear the risk of earning less income from a harvested crop by applying fewer fertilisers[9]. Meanwhile environmental government policies designed to reduce fertiliser applications were aimed directly at growers with no incentives (for example, tax rebates and payments) or disincentives (for example, taxes and regulatory penalties) to comply. These policies were not as influential as the financial and cultural[10] rewards provided by each mill. In contrast, agricultural government policies encouraged and rewarded increased productivity and inadvertently contributed to the poor reception of the environmental policies (Cheshire and Lawrence, 2005; Dibden and Cocklin, 2005).

Concern from the regional tourism industry, Green NGOs and the public for the health of the Reef and the way sugarcane is grown has escalated. In 2007 the newly formed federal government responded with investigations into potential financial incentives, such as land stewardship payments (Dibden and Cocklin, 2005) and potential use of regulations to limit fertiliser use, similar to the European Union (EU) nitrate initiative. Both of these initiatives have

[8] Mills are natural monopsonies as growers can only sell their harvested sugarcane to their closest regional mill.
[9] Even when the best science is available for how much fertiliser application is recommended, growers need long-term evidence that they will not lose income through the application of less fertiliser, particularly in the case of extreme weather events, such as floods, cyclones, etc.
[10] The 'cultural' rewards refer to the industry culture, for example, productivity awards, provided by the mills are given to the most productive growers at a special annual event with positive media coverage, including great community pride.

not been entirely successful overseas, especially when applied in isolation without an overarching policy framework. Before there is a leap to adopt policies borrowed from other countries it would be useful to examine the circumstances where these policies have failed. Agri-environmental policy has not been as successful in Australia as the rhetoric implies (Barr, 1994; Pannell, 2008) and it is time for a complete rethink on how government can achieve better environmental outcomes from agricultural industries in a more economically favourable manner. Before a discussion on a proposed better way forward for the sugar industry, there are some lessons to be learned from the ways that government policy shaped the industry since the 1860s.

2.3 Government Policy has Always Shaped the Sugar Industry

2.3.1 The Fear of Invasion and the White Australia Policy

The newly formed Queensland State government was, in December 1859, intent on opening up all possible parts of the state for economic development (Elder, 1996). Colonial and State Governments played a major role in the development of Queensland's sugar industry. The policy was to settle the 'wild' far north with large numbers of European settlers to prevent a feared invasion from Asian nations (and any other nations) and to establish export industries to the British Empire (Elder, 1996, 2001; Galloway, 1989).

At first early settlers tried growing nearly everything, but various types of crops failed in the Wet Tropics region (Bolton, 1972). By the beginning of the twentieth century, agriculture in far north Queensland had changed from the "try everything" enterprises of the early settlers to specialisation (Hudson, 2000; Kerr, 1995). There was a high demand for sugar in the northern hemisphere and the climate, rainfall and soil types in northern Queensland were ideal for growing sugar (Bolton, 1972). As crown land was made available for purchase, many investors and adventurers were attracted to the far north to make their fortunes. Some of these earliest settlers set up sugarcane plantations similar to those found in other tropical countries at the time (Elder, 1996, 2001; Galloway, 1989). Sugar became the dominant crop grown on the coast, while maize and dairying were best suited to the Atherton Tableland, inland from the coast (Bolton, 1972). Plantation owners and their mills initially made the production decisions during a period when agricultural land was viewed as a resource to be tamed and made suitable for the purpose of production and profit (Dibden and Cocklin, 2005). No thought was given to the environmental impacts of the production methods at that time. Instead, areas of land under cultivation were considered of great importance and value in improving the land and conditions for habitation (Bolton, 1972; Kerr, 1995).

Sugarcane plantations required a large labour force as all of the growing and harvesting was done by hand. Due to an increasing scarcity of available labourers in the 1860s and 1870s, indentured labour was sought from China, Japan and, in particular, the Melanesian islands. This steady supply of extremely cheap labour facilitated the rapid expansion of more land under sugar cultivation. In this remote region with its small population of white, male plantation owners and a high population of non-white workers, racial tensions escalated as fears were generated during the 1890s and early 1900s amongst the southern population over 'what colour' northern Australia was becoming (Elder, 1996, 2001; Reynolds, 2003). The Colonial and State governments were pressed by public demand from the southern States into supporting White Australia policies, while compelled to support the growing sugar industry in far northern Queensland.

The promotion of a tropically suitable industry, such as sugar production, seemed the ideal way of achieving both objectives at the same time. This view is evident in the Royal Commission 1912 (Queensland Government, 2003):

> The problem of the sugar industry today is not, save in subordinate respects, a problem of industry, of wealth or of production; it is primarily and essentially a problem of settlement and defence…The Commonwealth today is brought face-to-face with one of the gravest problems…the settlement of tropical and semi-tropical areas by a white population…If the ideal of a White Australia is to become an enduring reality, some means must be discovered of establishing industries in the tropical regions. So long as these regions are unoccupied they are open to invasion…it follows that the supreme justification for the protection of the sugar industry is the part that the industry has contributed and will, as we hope, continue to contribute to the problems of settlement and defence of the northern portion of the Australian continent…Relatively to it, all other issues are of minor importance.
>
> (Report of Royal Commission on Sugar Industry, *Commonwealth Parliamentary Papers*, 1912, III, p. xxxviii)

The Colonial Government actively encouraged the break-up of the plantation system and its replacement with small farms, in order to remove the Pacific island (Kanaka) labourers. Once sugarcane is cut, it needs to be processed (or milled) within 24 hours, so the construction of regional mills became another imperative.

These two objectives were achieved through the provision of government loans for the establishment of regional mills and a rebate on export bounties for sugar produced by white labour. The movement to eradicate the 'coloured' labourers culminated in the repatriation of many of these indentured workers who were replaced with labourers from Europe and in

particular Italy. The labourers from Europe were initially employed as cane cutters for the colonial landowners. The change to European labourers created more changes for the regional sugar industry and the local landscape. European workers were not indentured labourers and had no intentions of being treated as such. They quickly formed themselves into unions to demand a minimum wage and an eight-hour working day and the ensuing strikes created tensions between the cane cutters and the mill and plantation owners. Many of the cane cutters later bought small parcels of land and became cane growers, replacing the plantation system.

Land clearing was made a condition of land ownership. Improvements equal in value to the cost of the land (£1 per acre, paid in instalments as rent for ten years) were mandatory for entitlement to freehold title, and failure to do so resulted in forfeiture. Improvements constituted felling and burning forests, planting fruit trees or new crops, and establishing permanent buildings, sheds and fences (Kerr, 1995). 'Land improvements' (including vegetation removal), as a condition of land ownership, continued until the 1950s[11]. Consequently, removal of native vegetation on the coastal plain continued to advance and change the regional landscape.

As the demand for sugar increased, more land was cultivated and more mills were constructed to cope with the increasing demand. The assured trade relationship with Britain served to reinforce the view of the land as a resource for production purposes. The wilderness areas of the far north were not appreciated for their natural landscape values. The Europeans who settled the land were encouraged to fashion the landscape into a more European form that they could relate to and make an income from. For example, 'swamps' were viewed negatively as the threatening breeding grounds of stinging plants, malarial mosquitoes, snakes, crocodiles and a plethora of other 'nasty' creatures. They were considered as landforms that needed to be eradicated and transformed into productive land (Bolton, 1972; Hudson, 2000; Kerr, 1995). Figures 2a and 2b show aerial photos of clearing to make way for sugarcane cultivation, taken at the same site in the Tully mill area in 1937 and 2000 (Kemp, *et al*., 2007).

[11] Personal Communication, 2006, with the Principal Land Officer, Projects, Land Management and Use, Department of Natural Resources and Water.

Plate 2.1 1937 Aerial photo of a part of Munro Plains (Junction of the Tully River and Davidson Creek). Showing the natural grasslands of the plains terminating abruptly at the dense rainforests of the Tully River levee. (Distance across photo is approximately 2.5 km).

Plate 2.2 2000 Aerial photo of a part of Munro Plains (Junction of the Tully River and Davidson Creek).
The same area in 2000 (Kemp, *et al,* 2007) (with permission from Queensland Government, Environmental Protection Agency.)

2.3.2 Regulations as Policy Instruments

As the number of small farms increased, tensions emerged between growers and proprietary mills and, in particular, with the giant Colonial Sugar Refining company (CSR), which owned most of the nation's refining capacity (Galloway, 1989). Growers felt vulnerable to exploitation by mills and refineries and sought adequate legal protection against unfair dealings and abuse of power. Two Acts were thus passed to protect growers' and cane cutters' interests: the Sugar Acquisition Act 1915, to compulsorily acquire sugar; and the Regulation of Cane Prices Act 1915, to regulate the setting of the price paid for cane (Queensland Government, 2003). The new legislation created incentives for growers to remain as settlers in the far north and rewarded them for helping to achieve the government's White Australia policy. This heralded the beginning of a regulatory era in the sugar industry.

The regulations were detailed and complex. Farmers were obliged by regulations to deliver their cane to a particular mill. Statutory controls covered not only the amount and location of land 'assigned' to cane production, but also whether or not that land might be sold and at what price. Regulations also controlled the quality of cane grown, the amount of sugar produced and how it was marketed. The regulations may have seemed onerous but they ensured farmers' incomes to a large extent (Centre for International Economics, 2004) as they established a power balance between growers and millers (Antony, 2004). The sugar industry had become the most highly regulated agricultural industry in Australia (Cavanagh, 2000). In practice, the regulatory system functioned effectively because of the interdependence of different sectors of the industry (Drummond, 1996) until Australia lost its dominant and competitive edge on the world market. These regulations were to have repercussions on the future sustainability of the industry in the later part of the twentieth century.

2.3.3 Mechanisation and an Era of Productivist Policies

The Australian sugar industry steadily grew and continued to supply the British market. The labour crisis during World War II drove the sugar industry to mechanise. Machinery designed and built by Queensland cane growers to do the work of planting and harvesting sugarcane was now in high demand, and it saved not only time and money, but reduced the number of labourers. Farm owners were no longer vulnerable to striking cane cutters (Elder, 1996, 2001). By the 1960s the Australian sugar industry emerged as the most modernised and efficient sugarcane producing industry in the world (Bartley and Connell, 1991; Galloway, 1989). Both growers and the Australian government encouraged technological advances and invested in the development of modern farming methods, new machinery and various new plant varieties that

could withstand diseases and produce higher sugar content plants (Bartley and Connell, 1991; Bell *et al*., 1998; Braunack *et al*., 2006; Dick and Hurney, 1986; Grigg, 1984; Pankhurst *et al*., 2003; Vella, 2003).

Mechanisation also produced some positive environmental outcomes, even though the aim was to improve productivity. For example, mechanisation facilitated the change away from burning the cane just prior to harvesting to a system of 'green cane trash blanketing' (GCTB). Burning of the cane prior to harvest was originally introduced to kill the rats responsible for spreading the potentially fatal Weil's disease[12] that was rife amongst cane cutters in the 1930s. Once mechanical harvesting was introduced burning was less important. Cutting the cane green saved time and money and thereby improved productivity. By leaving the cane trash (the remains of stalks and leaves) on the ground and forming a 'blanket' of mulch, soil erosion was reduced during rainfall events and much less soil moisture was lost through evaporation. The 'blanket' also reduced the growth of weeds and thereby the need to use herbicides or to cultivate the land prior to planting. The change to GCTB by 98 percent of Wet Tropics cane growers (Parker and Rudd, 2006; Wrigley, 2005; Wrigley and Moore, 2006) saw the virtual disappearance of fields of fire and smoke-filled skies, whereby cinders rained on everything for weeks during the harvest season.

Mechanisation has had some negative environmental impacts. Machines burn oil-derived fuels. Mechanisation facilitated significantly increased areas that each farmer could cultivate; the easier removal of more trees and riparian vegetation; and increased ability to cultivate soils and thereby potentially increase the rates of soil erosion in a region known for its very high rainfall events[13] (Bell *et al*., 2003; Garside *et al.*, 2004; Mullins *et al.*, 1984). Heavy machinery can also cause soil compaction, which is countered by extra cultivation. While growers had an assured market in Britain and were becoming more and more technologically efficient, they were able to buy up more land and expand their farming activities, replacing more wetlands and riparian vegetation areas along the coastal plains. A sea of sugarcane steadily replaced the native vegetation and displaced the fauna that depended on it (Elder, 1996, 2001).

[12] Weil's disease was spread by rats urinating on the wet ground and on the cane stalks. It infected the cutters through cuts received while handling cane trash. It caused fever, muscular pain, depression and, in severe cases, internal haemorrhaging and death.
[13] During a high rainfall event, caused by big storms and cyclones, it is not unusual to receive a metre of rain in a 24-hour period in the Wet Tropics.

2.3.4 Divergent and Opposing Sets of Policies: Productivist Versus Environmental Policy

The 1980s were an era of change for the sugar industry. Several influences and pressures began emerging simultaneously. Generally, these influences fell into one of two policy domains: the environmental policy arena and the primary production policy arena. However, these policies were not integrated and so separate messages were emanating from separate agencies in both the Federal and State governments.

Australia had already lost its traditional agricultural markets when Britain joined the European Economic Community in 1973. The price of sugar was high in 1974 and again in 1980 (Queensland Government, 2003) and this, along with encouragement from the government, stimulated farmers to expand their operations. Farmers went into debt when interest rates were high in order to borrow during the 'good years'. Then deregulation commenced in 1986 in a worldwide move to liberalise agricultural trade (Prichard, 2005). Liberalisation included the removal of trade barriers and tariff protection and internal controls over production and this compelled farmers to become more efficient and self-sufficient. Meanwhile, environmental lobbyist groups, supported by scientific evidence (Great Barrier Reef Marine Park Authority, 2001b), related the damage done to the GBR to this time of expansion in the sugar industry. Concerns for the GBR escalated as the tourism industry boomed and the region's main source of income transferred from the sugar industry to the tourism industry. The tourism industry complained it was unfair that they pay a reef-user tax (used for protection of the GBR) while cane growers, depicted as perpetrators of the decline in coral health, didn't pay this tax and were not fined for their activities. After a century of being remote from the urban population and secure in its trade relations, the sugar industry had become more susceptible to external influences locally, nationally and internationally.

Government agricultural policy focused on size and efficiency issues with research in the 1970s pointing to the inefficiency of small farms. The new mantra with regard to the future of farming in Australia became "get big or get out" (Salmon and Weston, 1974). However, getting bigger did not always work financially. When the price of sugar fell again during the 1980s, farmers who had overcapitalised and borrowed heavily could not service their debts (Barr, 2004). Some of the bigger farmers had to sell their farms while the smaller farming families, who did not have unserviceable debts, were able to compensate their low income from sugar through off-farm work and other sources of income. Most of the farms sold had remained in sugar production (mainly due to legislative constraints protecting agricultural land), however, the declining terms of trade and the reducing income from sugar increased the push for greater

productivity and efficiency in terms of scale of production (Hungerford, 1996). Agricultural land was generally still viewed in terms of its use as a resource commodity (Dibden and Cocklin, 2005).

Greater areas of soil now under cultivation, combined with a decline in soil fertility, led to significant increases in overall fertiliser application. The very obvious run-off of soils (and nutrients) during rainfall events sometimes causes massive plumes of muddy water that extend several kilometres out to sea across the GBR (Brodie, 1996; Brodie and Furnas, 1996; Brodie *et al*., 2007). These plumes are also attributed to the removal of wetlands and riparian vegetation in an era of expansion in sugar cultivation during the 1980s (Great Barrier Reef Marine Park Authority, 2001b; Veitch and Sawynok, 2005). Extensive scientific research has been conducted into the sediment and nutrient pathways from farms to the waterways and then the Reef. When growers apply more fertilisers than the plants can use, the excess nutrients can leach into waterways and volatilise into the atmosphere. For example, high nitrogen concentrations have been found in soils (Meier *et al*., 2006), coastal groundwaters (Thorburn *et al.*, 2003a) and rivers (Bramley and Roth, 2002; Thorburn *et al.*, 2003b) associated with sugar production. Scientific evidence has linked these plumes of sediment and nutrient to the declining health of the corals (The State of Queensland and Commonwealth of Australia, 2003; Great Barrier Reef Marine Park Authority, 2001a, 2001b).

Growers had generally adopted new technologies enthusiastically, but were more hesitant to support the environmental movement with regard to some of their recommended practices. Hildebrand suggests that (2000:59) "The sugar industry has tended to isolate itself in the environmental debate", despite having been a leader in adopting many practices that had positive environmental outcomes. Although there is evidence of impressive adoption rates of some recommended practices (see Appendix 2 Uptake of Good Farming Practices by Sugarcane Growers), the sugar industry has been slower than some other agricultural industries in acknowledging its environmental impacts and in engaging in the debate. There has been a recent shift in the way that the sugar industry representatives have responded to criticisms about their ecological performance. Until 2002, most people in the industry, particularly Canegrowers Association (a sugarcane grower representative group that lobbies on behalf of grower interests) and the majority of growers believed they had little or no impact on the health of the waterways and the GBR. In 2003 the Canegrowers Association took a new direction whereby both the Association and many of the growers have admitted that the growing and milling of sugarcane had caused some damage to the environment. The Canegrowers Association is now liaising with other organisations about environmental matters and providing information for growers on ways

to improve their environmental performance and credentials (Wrigley, personal communications, 2006, 2007).

Growers were facing financial situations that could encourage exploitation of the environment and there was little financial incentive to adopt environmentally friendly management practices (Vanclay, 2003). Nevertheless, many farmers had voluntarily changed their practices and now provide models of multifunctional agricultural land use incorporating constructed wetlands and revegetated areas along creeks and drains. These model farms provide examples to other farmers to emulate. However, significant costs in materials, construction and time, along with reduced productivity, would not encourage many farmers to follow suit.

By the late 1990s and the early 2000s the public concern for the health of the regional waterways and the GBR had influenced government policy, resulting in the development of two particular policy instruments: the Regional Coastal Management Plans (RCMP), developed as a requirement of the Coastal Protection and Management Act 1995; and the Reef Water Quality Protection Plan or 'Reef Plan' (The State of Queensland and Commonwealth of Australia, 2003). The RCMP developed for the Wet Tropical Coast (Queensland Environment Protection Agency, 2003) contains a section of State and regional policies that pertain to water quality and to rural land uses. The Reef Plan "contains new actions and proposals for building on existing government policies"[14] and was specifically designed to marshal government and industry efforts to reduce run-off of sediment, nutrients and pesticides to the GBR and protect existing wetlands. In brief, these policies failed to redress water quality issues due to: the use of weasel words[15] and rhetoric in the policy statements; the lack of fully integrated environmental policy into the operations of all departments of government; the lack of clear, precise, achievable and measurable targets and standards; and lack of penalties for non-compliance.

Although government plans sought to encourage good farming practices, they remained voluntary. Under Queensland's *Environmental Protection Act 1994* agricultural activities were exempted. Agricultural activities were also exempted from the *Environmental Protection (Water) Policy 1997* until the environmental values were established for each region's waterways[16]. By default, the Queensland State government continued to defer to industry codes

[14] Quoted from the former Queensland premier, Peter Beattie, and the then Prime Minister of Australia, John Howard, in the foreword of the Reef Plan.
[15] 'Weasel words' are the colourful words that narrow the range of thought, inflate language, avoid responsibility, alleviate the discomfort of the waffling speaker, make the bad sound good, are at variance with the real or purported meaning, or are a misnomer, euphemism or evasion (Wasserman and Hausrath, 2005).
[16] This process of establishing the environmental and water quality values has commenced and is a very time consuming and complex process, requiring huge resources and still may not deliver the desired outcomes.

of practices and expected sugarcane farmers to follow the industry Code of Practice, published by the Canegrowers Association (1998). This Code of Practice was later updated and replaced by a set of five booklets on Best Management Practices as part of a Farm Management System for growers (Wrigley, personal communication, 2007) and the 'Six Easy Steps' publication (Schroeder *et al*., 2005) which outlines a set of simple and clear guidelines on nutrient management for sugarcane growers (refer to Appendix 3 for details on the Six Easy Steps).

Extension officers are employed by industry and government to support farmers with access to information and training in recommended practices and ways to increase productivity. Grower adoption of these measures is encouraged but not mandatory. Productivist primary production policies caused growers to change their practices. They had little choice, but the majority also welcomed these changes because they were coupled with improved profits. On the other hand, environmental policies encouraged farmers to voluntarily change some practices, while often contradicting or competing with productivist policy.

By the late 1980s it was estimated that restrictive controls in the Australian sugar industry increased costs by A$200 million and restricted exports by A$500 million per annum (Robinson, 1995). Where once the regulations had been used to solve problems in the sugar industry now these regulations were creating new problems for international trade relations and therefore had to be dismantled. Deregulation has not yet completely dismantled the old system and many of the structures are still in place.

Removing subsidies further aggravated already declining profitability of the industry in the 1990s. This impeded the transition and led to running down the resource base, in particular soil fertility (Keating *et al*., 1997). With the removal of trade protection Australia became more exposed to competition from countries that still provided subsidies for farmers. The removal of trade protection had a very big impact on farmers. The cost-price squeeze caused by price deregulation and subsidy reduction resulted in reduced incomes (Antony, 2004). Farmers felt betrayed by their government and were angry that they were forced to comply with the 'level playing field' rules, when competing countries (especially in the EU and USA) were still subsidising their farmers (Dibden and Cocklin, 2005; Elder, 2001).

To sum up, government policy affected the structure and culture of the industry in profound ways. The most effective policies were focused on productivity outcomes and were supported by regulations, tariffs and subsidies. Environmental policy measures were the least effective, lacking in cross-agency integration, strict standards, timelines and penalties. Meaningful policy

integration and coordination was hindered by the segmented approach that dominates traditional government policy development.

2.4 Mills Have a Role to Play

The discussion so far has focused on the role of government policy on farming practices in terms of environmental and productivity outcomes, but the mills also play an important role. Focusing environmental policy measures on cane growers without taking the influence of the mill into account will not succeed. There is mistrust between growers and millers that harks back to the days of plantation farming when the plantation owners were the lords and masters, exercising control in all aspects of the growing, harvesting, transporting and milling of the sugarcane (Antony, 2004). Moreover, there are historical tensions between the growers and the mill over a range of issues including: the quality of cane delivered to the mill, prices paid for sugarcane and the mill's 'free' access to by-products from the milling process (such as bagasse used to fuel the mill). The influence of the mill on grower decisions and activities cannot be underestimated. While the farming sector has borne the brunt of complaints about the environmental performance of the sugar industry and has been under pressure to change farming practices, very little focus, if any, has been placed on the role that mills play in hindering or facilitating environmental management on farms. That influence on grower practices will be examined in the thesis.

2.5 Conclusion

The landscape of the Wet Tropics was transformed over a long period. Today's local residents have no memory of the original landscape but they do want to preserve the current landscape and expect farmers to produce their crops in ways that sustain the regional ecosystems and the tourism industry. The sugar industry is continually facing substantial economic threats and environmental and social pressures. Perhaps mills will diversify and find new ways to be profitable. Some mills may cease to exist in this period of economic rationalisation but we cannot suppose that eradicated cane fields will be restored to the former wetlands. More likely they will be replaced with often inappropriately designed housing developments or vast monocultures of unproductive tree plantations used for carbon offsets causing even greater transformations of the landscape with potentially less sustainable outcomes.

Environmental management in the sugar industry might be more effective if governments developed policy in a more coherent and coordinated manner and try to prevent the

development of conflicting policies. Governments could gain more, better and faster environmental outcomes by working much more closely with industry and finding out more about the complexity of industries and their subtleties that can get in the way of agreed advances in eco-industrial progress. A policy that runs counter to a business' prime purpose to make a profit cannot be expected to be welcomed unless compensation is awarded. Well researched and agreed strict standards that allow for flexible implementation are more effective than regulations in both the short and long term. When these strict standards are applied in unison with a range of industry incentives such as grants to modernise or tax exemptions where standards have been met, there would be greater support for change from industries such as the sugar industry.

Government policy will continue to have an obligation to manage industrial externalities and better protect the environmental and landscape values without necessarily compromising the economic sustainability of the sugar industry. In the next chapter I explore ways that environmental policy can fail and alternative ways that policy can be better developed by examining the sugar industry's performance through the lens of Ecological Modernisation Theory (EMT) and then by looking to Foucault's knowledge/power relations for insights into the way the environmental problem was constructed and managed.

Chapter 3 Theoretical Framework

3.1 Introduction

The aim of the thesis is to present alternative perspectives on the 'problem' of non-adoption that can help inform better environmental policy development. Rather than focusing attention on the growers in isolation, the research examines how the relationship between growers and other stakeholders might influence the adoption of certain government-recommended environmental practices. This chapter outlines two conceptual frameworks that can be used for explaining why sugarcane growers resist adopting recommended fertiliser application rates for the Wet Tropics. In the first section I outline Ecological Modernisation Theory (EMT) as a theoretical basis for examining the ways that government policy has been effective or unsuccessful in achieving sustainable development outcomes and ecological reform of the sugar industry. In the second section I turn my attention to Foucault and the knowledge/power relations that ultimately construct the way that environmental problems are perceived and managed.

EMT motivations are aligned with those of Ecologically Sustainable Development (ESD). EMT is industry-centric and focuses on ways of facilitating the ecologisation of industry in a manner that also improves profitability – creating a win-win situation for industrial and environmental outcomes. The theory was conceived as a way of identifying the elements *within* the capitalist system, which can provide successful ecological reform in industry without having to radically restructure society. It is based on the tenet that industrial innovation needs to be environmentally and economically effective to be attractive to industry, and that if environmental reforms are not economically viable they will be unsustainable and hence not adopted by industry. EMT is a useful theoretical framework for gaining an understanding of the contemporary dynamics involved in environmental reform through state intervention (Mol and Spaargaren, 2002).

Although EMT analysis is useful, the insights it provides to particular research project are limited. The fact that recommendations for reduced fertiliser use were introduced in response to an environmental problem raised questions about why that particular response was chosen, how efficient it might be in solving the problem, and how it related to results of scientific investigations. These questions necessitated a deeper investigation into the role of science and scientists in the adoption of the recommended fertiliser practice. Foucault's theories of knowledge/power and governmentality provide a theoretical framework for understanding the relation between scientific knowledge and the sugar industry participants that affected growers'

non-adoption. Indeed, a key issue examined in this thesis is the role of 'science' and how that science underpins environmental policy.

Foucauldian perspectives draw attention to forms of power that permeate and order the contemporary world of environmental policy. In this study the knowledge/power relations between scientists, growers and policy makers are explored to understand the construction of environmental policy. The approach described in this chapter provides deeper insights into why some environmental policy measures have failed with sugarcane growers.

In Part One of this chapter EMT is discussed and critiqued as a framework for shedding light on the suitability and sustainability of an innovation. Part Two presents Foucauldian as a framework for analysing the power relations that shaped the policy choices made in this study and the knowledge upon which these decisions were based. The two theoretical frameworks provide different ways of knowing and understanding growers' resistance to adopting recommended fertiliser application rates. In combination they provide a new and useful means of explaining the ways in which the environmental 'problem' has been constructed and managed.

3.2 Part One – Ecological Modernisation Theory (EMT)

3.2.1 Core features of EMT

EMT is a contested concept and there are many interpretations (Mol and Sonnenfeld, 2000). A version of EMT that clearly outlines the core features that help determine a government's success or failure to ecologically modernise industry is therefore useful for this research. Mol's (1999) four core features of EMT can be adapted and used for this purpose:

- Science and technology are the principal domains involved in ecologising the economy and in devising ways to dematerialise natural resource inputs and polluting outputs (through waste reduction and elimination, and resource recovery and reuse).

- Environmental improvement can go together with economic development via a process of de-linking economic growth from natural resource inputs and pollution (emission and waste) outputs. Economic and market dynamics are important for stimulating ecological reform and innovation.

- State intervention should move away from hierarchical command-and-control methods to more decentralised, consensual negotiations, self-regulation (within strict boundaries) and use market mechanisms and instruments such as the promotion of 'green' products, environmental audits, standards and certification and innovative incentives and taxes.

- Environmental NGOs have adapted their early ideologies of de-modernisation or anti-modernity that put them on the outside of the system to perspectives that enable them to be critical and independent participants working more closely with government and industry on environmental issues. They are a critical force in generating ideas, mobilising consumers and organising public support or disapproval.

When applying strict standards governments need to have an excellent level of understanding of a polluting industry's economic issues in order to support innovation with 'carrot-like' policies. Collaboration is such an important element for the success of EMT policy that it could be stressed more strongly within Mol's list of core features. When all of the core features of EMT are applied to policy there is the potential to radically reduce the environmental burden of industrial growth. Many consider it the best alternative under current political and economic circumstances (Jänicke, 1990, 2007; Jänicke *et al*., 2000; Mol 1997, 2000; Mol and Sonnenfeld, 2000; Mol and Spaargaren, 2002; Seippel, 2000; Simonis, 1989; Spaargaren and Mol, 1992). In concert with Hajer (1995), even the most cynical might view EMT as at least providing a pragmatic option for encouraging ecological reforms in industrial processes.

This chapter now turns to the origins and development of EMT as well as criticisms of its approach. Despite these criticisms Mol's four core features remain a clear, concise and constructive guide for critiquing the effectiveness of innovations and policy development. This study uses Mol's features to critically analyse governmental attempts to devise effective policy to support the sugar industry and sugarcane growers to ecologically modernise their practices while simultaneously becoming more economically sustainable.

3.2.2 EMT policy

Conventional environmental policy expends resources on repairs to environments damaged or degraded during the process of economic growth, such as in the clean-up of toxic waste dumps or polluted waterways. This is *post-hoc* policy that reacts to the damage done rather than preventing damage in the first place. It is also a costly policy for government. For example, in

1985 the annual damage to the natural environment in the Federal Republic of Germany (FRG) was estimated to cost 103 billion DM, or 6% of the Gross National Product (Simonis, 1989). The Australian total national expenditure for environmental protection during 1996-97 was estimated at A$8.6 billion, or 1.6% of the nation's gross domestic product (Australian Bureau of Statistics, 1999)[17]. Conventional environmental policy has many shortcomings besides the costs borne by taxpayers. It also tends to identify the given problem too late for adequate protection of the affected ecosystems (Simonis, 1989).

During the early 1980s, against a 1970s backdrop of failing state environmental policy and an environmental movement sympathetic to radical restructuring of society (through de-modernisation or de-industrialisation), the concept of ecological modernisation emerged. EMT was developed by a small community of social scientists referred to as the 'Berlin School' of environmental policy research. The foundations of this theory were developed by the sociologist Joseph Huber (1982, 1985) and political scientist Martin Jänicke (1988, 1990, 2000, 2002, 2003, 2007) but their work has been extended by others such as Simonis (1989), Mol and Spaargaren (1992, 1993, 1997, 1998, 2000, 2002, 2004, 2005) and Weale (1992). The basic premise of EMT is that the central institutions of modern society can be 'transformed', rather than radically restructured, in order to avoid ecological crisis. Rather than the deep ecological position of a radical restructuring of society, EMT has more in common with ecologically sustainable development in that it encompasses progressive modernisation of the institutions of modern society as opposed to their destruction or dismantlement (Gibbs, 1998). EMT was presented as a new way of approaching the development of environmental policies and reorienting the counter-modernity approach of the environmental movement, without abandoning claims for environmental improvements and reforms (Mol and Spaargaren, 1993).

EMT is deployed to analyse the transformation of central institutions in modern societies to achieve ecological industrial reform through improved modes of production and consumption. The state can facilitate ecological industrial reform to be more economically viable through the use of economic measures such as eco-taxes, valuation of natural resources, and economic incentives for ecological production and consumption. Eventually the flow-on effect leads to an evolution of the way that institutions and organisations function in society to produce a more ecologically modern economy.

[17] It is no longer possible to find explicit data on the Australian national expenditure for environmental protection since 1999.

The EMT policy style is in the form of standards, audits and other similar instruments. Strict standards are set but flexible implementation is applied to achieve policy goals and this allows for increased creativity in innovations and the speed at which they are implemented. In order to set standards, the state has access to instruments such as: Environmental Management Systems (EMS), annual environmental reports, environmental certification systems (ISO 14000), and environmental audits. Similarly, incentives can be applied such as the removal of licensing fees upon completion of an EMS or a reduction in taxes when meeting emissions targets. Changes to systems over the last ten to fifteen years have been radical and represent transformational processes that move beyond the individual firm. Customers ask about the certifications, new marketing strategies, and new product information standards, and insurance companies carry out environmental audits before insuring various companies. Some banks even make investment loans conditional on an environmental evaluation (Mol and Spaargaren, 1998). These kinds of mechanisms are part of a suite of governmental instruments such as the introduction or removal of taxes or subsidies that can improve ecological reforms. Moreover the power of public pressure articulated by NGOs and international agreements cannot be underestimated (Mol and Spaargaren, 1998).

EMT is highly dependent on a technology-based and innovation-oriented approach to environmental policy. Modern technology is presumed to provide the tools for an ecological reconstruction of society's institutional organisations. Huber (1982, 1985) emphasised that this is a process of progressive modernisation which presents us with a paradox: the way out of the environmental crisis arising from modernisation is through technological advances that arise from further modernisation.

One of the premises of EMT is that an environmental pollution problem proves politically less difficult to resolve if a cost-neutral or marketable solution exists. In contrast, if a solution to an environmental pollution problem requires an intervention in the established patterns of production, consumption or transport, it is likely to meet resistance. Modernisation, in economic terms, is the continual improvement of production processes and products. Modernisation is a consistent feature of capitalistic market economies, and the increasing competition for innovation in industrialised countries has led to the continuous acceleration of technological modernisation. An ecologically modern form of governance seeks to influence progress in a more ecologically oriented direction to achieve 'win-win' solutions can result in cost reductions and market advantages for industry. An EMT-oriented government thus plays a key role in supporting both the 'greening' and the 'acceleration' of technical progress (Jänicke, 2007). Lundqvist (2000) provides a snapshot of the characteristics of 'traditional' environmental policy

compared to EM policy (see Figure 3). Environmental protection agencies in the countries that have advanced these EMT concepts have reduced costs, created markets, driven innovation, reduced business risk and assisted the competitive advantage for industry. An EMT approach to environmental policy is a more comprehensive approach that focuses on environmental improvements through resource efficient innovations. Improvements may be incremental such as *cleaner* production technology or radical such as *clean* production technology (Jänicke, 2007).

Table 3.1

Characteristics of 'traditional environmental' and 'ecologically modernised' policies (Lundqvist, 2000: 22).

Characteristics	'Traditional Environmental' Policy	'Ecologically Modernised' Policy
Social problem	conflict, zero sum	consensus, positive sum
Economic problem	adjustment of growth	'greening' of growth
Policy principles	react/cure PP[1]	anticipate/prevent, PPP[2]
Main instruments	legal administrative	economic, informative
Administration	compartmental	integrated
Role of science	problem discovery cause/effect analyses	problem solution, eco-technology promotion

Note: [1] Polluter Pays. [2] Pollution Prevention Pays.

Due to market failures (resulting in economic externalities) innovations may need political support. Global industrial growth creates an increasing demand for environmental innovations since natural resources are scarce and the sink capacity of the earth is limited. Politicians can provide support for technology-based and marketable solutions and thereby cooperate better with industrial innovators (Huber, 1982, 1985; Jänicke, 1988, 1990, 2003, 2007; Mol and Spaargaren 1993, 2000, 2002; Spaargaren and Mol, 1992). Traditionally, regulations have been devised to enforce specific practices, rather than the use of strict standards that allow for flexible methods of implementation. Regulations often result in costly, ineffective and inflexible methods which stifle innovation and competitiveness (Jänicke, 2003, 2007; Mol, 1997). Most of the countries that experienced command-and-control methods of regulating the environment reported the failure of these methods, whether they were dictatorships or democracies. Mol (1997), Mol and Spaargaren (1998) and Spaargaren and Mol (1992) advocate a less adversarial

manner in contrast to inflexible regulations that allows industry to use its own ingenuity. The state can also provide the conditions, either via economic mechanisms or via public pressure (such as citizen groups, environmental NGOs and consumer organisations), to stimulate social 'self-regulation'.

Eco-modernists do not assume that the collaboration of government, industry and the environmental movement is easily achieved. A government that works within an EMT approach to policy needs to take an active role in providing oversight and guidance to the process. Such a government needs to create an atmosphere of corporate innovation and environmental citizenship rather than a traditional-pragmatist approach or adversarial relationships with industry characterised by command-and-control regulations. EMT has embraced the concept of increased reliance on market mechanisms of environmental protection. Within an EMT context policy needs to be designed in a way where all parties work together and are in agreement that the desired outcomes will facilitate improved productivity or a market edge for industry while attaining improved ecological results. The EM regulatory reform in environmental policy used in Europe was not just a technical change in policy tools, for example, but implied and required several types of societal changes. Governments used a variety of policy measures to intervene and change the behaviour of citizens, markets, companies and other organisations. Environmental ministries could not just dictate the contents of sustainable development to other policy sectors. Instead a more consensual style of cooperation was required, often reflected in self- and co-regulation methods (Sairinen, 2002).

The top six countries with the most successful environmental policy innovation and performance during the 1980s and 1990s all used an EMT approach: Germany, The Netherlands, Sweden, Norway, Finland and Japan (Dryzek, 2005). The Netherlands adopted a National Environmental Policy Plan in 1989, designed to fully integrate environmental criteria into the operations of all departments of government. Since then the Plan has been published every four years and each year a State of the Environment Report ascertains progress. Beyond The Netherlands, Norway has pioneered 'green taxes', and Sweden has pioneered integrated pollution control. In most nations, anti-pollution policy is organised around single-medium and single-substance legislation and regulation. However, in Sweden, licences for new manufacturing plants have been issued only after consideration of the *total* emissions of the plant, and what might be done to reduce them to an acceptable level (Lundqvist, 2000; Dryzek, 2005). Along with The Netherlands, Sweden has led in integrating environmental principles across all departments of government, coordinated by key cabinet ministers serving on a delegation for ESD.

Since the 1990s, some countries developed environmental policy instruments in keeping with EMT concepts that created markets and supported industrial competitiveness (and were not based on inflexible laws). Governments have helped to develop markets for 'greener' products by creating incentives and where necessary by removing disincentives. One example was the Japanese Top-Runner policy for the country's 21 best energy-efficient products, which applied an innovation-friendly approach to encourage ecological modernisation of industry. The government gave annual awards for energy efficient products: the 'top-runner' (or winning product) for energy efficiency then set the national efficiency standard for producers and importers of that product when the target year had been reached. A 'name and shame' approach was also used as an intermediate instrument, promoting the best and shaming the worst. This proved to be a highly influential method of encouraging the development of energy efficient products. It worked so well that several companies achieved the standard before the target year and producers confirmed that the competitiveness of their products increased (Jänicke, 2007). When nations apply this type of policy and environmental standards system they transform industry risk so that 'dirty' industries face a higher degree of uncertainty and greater pressure to innovate. Because companies need a minimum of investment security for the production and marketing of their products, being labelled as a 'dirty company' places them at a disadvantage (Jänicke, 2007).

In this section, the details and advantages of EMT have been outlined. The next section includes a critique of EMT by a variety of authors. In many of these cases the authors are not against EMT per se but are criticising particular aspects of the theory they consider to be shortfalls or weaknesses.

3.2.3 Critique of EMT policy

A substantial body of literature and a number of pointed criticisms have emerged over the years. Some authors argue that EMT is not a proper 'theory'. Buttel (2000) argued that the phenomenon it describes is just a part of modernity and did not develop primarily from a pre-existing body of social-theoretical thought. Both Buttel (2000) and Seippel (2000) have asserted that EM is more of a concept than a theory. This section provides an overview of the major criticisms of EMT and investigates these criticisms from the perspective of the original intentions and constraints of EMT.

EMT has been criticised as a weak means of accomplishing environmental reform by Murphy and Gouldson (2000) in their assessment of the British attempt at a form of ecological modernisation when Integrated Pollution Control (IPC) was introduced in England and Wales as

part of the Environmental Protection Act 1990. They commented that IPC provided some improvements to industry's environmental performance but had a flawed methodology and did not produce effective results. These authors attribute such failure to the IPC regulations that only required companies to apply BATNEEC (Best Available Techniques, Not Entailing Extensive Costs) or Best Practicable Means (BPM) rather than aiming at achieving particular environmental objectives. They argued that government policy would have approached a more EMT style if it had applied policy that encouraged companies to aim at BAT without the NEEC. Murphy and Gouldson's (2000) criticism that tweaking old command-type technologies (end-of-pipe style) can be achieved for many years, but eventually will need to be radically rebuilt or replaced, is a valid criticism that is not ignored in EMT. Technological changes need to be made in combination with organisational changes to ensure successful integration within the system and can be carried out over a period of time as industrial history has demonstrated. The IPC example described in their study illustrates an attempt to modernise industry without applying all of the core features of EMT.

Achieving EMT-type reform requires strategic state planning and the promotion of structural change at the macro-economic level to achieve less resource intensive means of generating wealth. Jänicke (2007) and Neale (1997) both argue that self-regulation alone does not work without the use of 'carrots and sticks' and innovative industrial standards that come from the industries themselves. There needs to be strong political support from the top for technical innovation to be utilised. In countries such as The Netherlands and Germany governments have assisted corporations with information on more ecologically efficient, less risky and more profitable alternatives. In collaboration, environmental groups have been more effective in working with industry to achieve environmental goals rather than in pressuring government agencies to take stronger regulatory action (Humphrey *et al.*, 2002).

Some critics consider EMT to be overly optimistic about the technocentric premise of reform and believe there may be structural limits that make it impossible to continually realise combined economic and environmental improvements as a result of innovation (Blowers, 1997; Hannigan, 1995; Murphy and Gouldson, 2000; Redclift, 1999). These authors have also condemned EMT for maintaining corporatist structures based on economic rationality with an undemocratic reform process. Beck (1992a, 1992b), Giddens (1991) and Lash *et al*. (1996) add to this argument and warn that modern industrial society has become less secure about its future and is increasingly questioning the faith that it has traditionally placed in science, technology and the institutions of government that EMT relies on. While criticised for being overly optimistic about the merits of technology, scholars deploying EMT observe that in most

political-economic systems the best way to get results in the short-term is with scientific and technological innovations that can be applied in a manner that enhances industrial productivity. A modern conceptualisation of technology and technological change has since widened considerably, from the original add-on technologies that were so severely criticised in the 1970s to a more radical structural change of socio-technological systems (Mol and Spaargaren, 1998).

Scholars criticise EMT for sustaining a capitalist system that they consider to be the root cause of the way that resources are used. Blowers (1997), Christoff (2000, 2002a) and Dryzek (2005) stress that EMT has overly optimistic ideas of environmental reforms in social practices, institutional developments and environmental discourses, and tends to neglect consumption and life-style issues. Christoff (1996) and Gouldson and Murphy (1997) accuse EMT of legitimising and sustaining the systems and structures they hold responsible for creating the environmental problems. Dryzek (2005) argues that capitalism outweighs EMT in the corporate ordering of political influence, rather than ideological frames. Milanez and Bührs (2007) and York and Rosa (2003) emphasise that even where EMT policy had been successful, overconsumption problems still remain an issue due to the growing ecological footprint of developed nations. Buttel (2000) and Murphy and Gouldson (2000) criticise the emphasis on the transformation of industry and the preoccupation with efficiency and pollution control over broader concerns about aggregate resource consumption and its environmental impacts. In concert with other authors they also hold the view that there is an uncritical stance towards the transformative potentials of modern capitalism.

In response to these criticisms it could be argued that EMT does not prescribe nor proscribe capitalism *per se*, rather it was designed to work within that paradigm for pragmatic reasons because capitalism was and still is the dominant economic system. EMT theorists focus on ways that the market (in a capitalist society) can increasingly contribute to a more sustainable form of development (Gouldson *et al*., 2007; Mol, 1999). Within the capitalist system of developed nations, new concepts have emerged such as environmental accounting and bookkeeping, annual environmental reports, green gross national product (GNP), environmental efficiency, environmental productivity and environmental auditing. It is these kinds of concepts that establish a link between EMT as a general theory of societal change on the one hand and EMT as a political program or policy discourse on the other (Mol and Spaargaren, 1998). The fact that environmental considerations have been increasingly institutionalised and do not wither away during an economic depression or crisis means that the conduit to the traditional and dominant institutions and organisations that ‘rule the capitalist world economy’ has been

maintained (Mol and Spaargaren, 1998). In other words, the dominant economic system is still in place, however, the boardroom psyche has changed.

Some industries might become 'modernisation losers' when they experience reduced profits from less consumption of natural resources. This would include industries involved in mining raw materials or generating power for example. It is possible that large and powerful industries could persuade government away from making policy changes that might cost them in reduced revenue. Jänicke (2007) asserts that EMT policy could support modernisation losers by promoting diversification of industry products or through the provision of social cushioning, retraining or conversion of the workforce. To achieve this polluting industries and government would need to work closely together to develop appropriate policy instruments. For example, prices of environmentally sensitive goods could be influenced by policy and play a critical role in dealing with environmental problems (Weidner and Jänicke, 2002). 'Modernisation losers' would present a challenge for any government. EMT policy measures that could be used to manage this issue would require strong leadership from government, concerted pressure from NGOs and public support. EMT policy may develop to form part of a progression towards the adoption of industrial ecology in developed nations and then produce a flow on effect in peoples' purchasing patterns. "What seems to be a slow, gradual but steady process of change today may turn out to be a wholesale restructuring of industrial society some decades from now" (Mol and Spaargaren, 1998: 34).

There are criticisms that EMT divorces social justice issues from environmental issues, is silent on society-nature relations and focuses too much attention on environmental issues in advanced industrial countries (Fisher and Freundenberg, 2001; Gouldson and Murphy, 1997; Murphy and Gouldson, 2000). Blowers (1997) criticises EMT for neglecting the social context of change and ethical issues such as inequalities of wealth and power, which affect the way that environmental problems are defined and environmental institutions are designed to respond to them. However, these criticisms reflect an expectation of EMT that extends beyond the vision and boundaries of the original theorists. Criticism of the limited geographical relevance of EMT to environmental problems in advanced industrial western nations and in particular to northern Europe (Sonnenfeld and Mol, 2006; Buttel, 2000; Murphy and Gouldson, 2000) casts doubts about EMT as a 'solution' to environmental problems over the longer-term. Gouldson, Hills and Welford's (2007) study of EMT applied in Hong Kong was critical that EMT under-emphasises the extent to which modern societies and their institutions depend on existing cultural, legal and historical approaches that can make them resistant to change. In contrast, Weidner and Jänicke (2002) argue that some aspects of EMT might be stronger in non-European and non-western

countries, while other aspects might fail. This indicates the need for further research on a variety of case-study nations and circumstances to refine the particular cultural mores that enhance or disable a successful EMT approach to policy. These insights do not necessarily weaken EMT but rather add to the knowledge base of its limitations and areas where more 'precise' policy development could be applied that is compatible with each nation's circumstances (Sonnenfeld and Mol, 2006; Weidner and Jänicke, 2002; Jänicke, 2007). Research into the varying applications of EMT around the world will continue to provide evidence of effective policies and ineffective policies from which all nations can learn. The greater our understanding of the sociological circumstances that influence each nation's actors – bureaucrats, politicians, scientists, industries, NGOs and consumers – the better the potential for developing and tweaking more effective EMT policy and industrial innovations.

EMT has been criticised for being a failure in cases where nations export and externalise their pollution by importing rather than producing certain goods (Pepper, 1998; Revell, 2003; Sonnenfeld, 2000; York and Rosa, 2003). This merely relocates the environmental problems to industrialising and developing nations. In cases like the South-East Asian pulp and paper mill industries, they have not really dematerialised[18] in the north as much as supermaterialised[19] in the south, especially in Asia (Sonnenfeld, 2000). Issues such as the supermaterialisation of resource consumption and production that have been exported to developing nations need to be addressed. Within an EMT paradigm, these issues are more likely to be addressed when the developing nations become more developed and are in a better position to gain the necessary governmental, industrial, NGO and public support to adopt an EMT policy approach. Although this may take time the trend is that EMT policy that works in economically successful nations is more likely to influence other nations.

Some scholars stress that high risk issues that occur on a global scale, such as biodiversity loss, climate change and ozone depletion, cannot be dealt with within the EMT framework of a single nation (Davidson and Frickel, 2004; Mol and Spaargaren, 1993; Weidner and Jänicke, 2002). Where nations do not have the capacity to deal with global environmental issues, the nations that are further along the EMT route have tended to be the ones more willing to sign international treaties to take measures to halt their countries' contributions to such issues.

[18] In EM, dematerialisation is achieved through the substitution of high technology for raw material inputs, or alternatively, the substitution of recycled or recovered waste for virgin raw materials (Sonnenfeld, 2000).
[19] In SE Asia's pulp industries they now use less water, less chemicals and produce less waste (dematerialisation), however these industries are proliferating very rapidly (especially in Indonesia) and all depend on huge volumes of virgin fibre; constituting supermaterialisation (Sonnenfeld, 2000).

Lastly, EMT has been criticised for falling short of the goals of ESD (Blowers, 1997; Christoff, 2000, 2002a, 2002b; Langhelle, 2000). However, it is primarily the leading EMT policy nations that have stimulated the internationalisation of environmental policy with the benchmarking of environmental standards and regulations, eco-labelling, research and development (R&D) expenditures and the creation of new institutions (such as United Nations Environment Program, Commision on Sustainable Development, World Bank, Organisation for Economic Co-operation and Development and International Union for Conservation of Nature) with active monitoring and reporting on innovations (Weidner and Jänicke, 2002).

There are many things that EMT does not attempt to achieve. EMT is, above all, a concept dealing with the institutions of modern technology, market economy and state intervention (Mol, 1997, 1999). Mol (1999) claims that reforms in environmental policy can be classified as examples of EMT if they move away from a purely hierarchical, state-dictated model of environmental change; they increase flexibility and involvement of non-state actors via negotiations, market mechanisms and dynamics, and undertake self-regulation[20] within legal and state-set boundaries; and if the technological dimensions of environmental reform also include organisational adaptations. Nations successfully employing EMT have a combination of flexible and cooperative instruments and procedures linked with demanding goals. Countries with political and cultural structures and capacities that favour a corporatist model, consensus decision-making, cooperation and integration have a greater advantage. The political and cultural context has been important for developing a co-operative policy style (between different government departments, industry and NGOs) that can promote policy change through an early integration of innovators (Lundqvist, 2000).

EMT has thus been developed both as a way of analysing emergent policy discourses and as a theoretical basis from which policy can encourage a shift toward more environmentally benign modes of industrial development. In this way EMT has a positive-sum approach that can reconcile conflict between business, government and environmentalists while stimulating innovations and new markets for greener production and it provides better alternatives than the less successful *post-hoc* remedial strategies. EMT has some winning attributes that appeal to politicians, industry and environmental lobbyists and it does not challenge the existing social order and capitalist economy (Hajer, 1995). An EMT approach also reflects a longer-term view of environmental policy than the conventional approach (Stubbs and Cocklin, 2008).

[20] Examples of self-regulation include: EMS, EMP and ISO14000 certification.

Some consider that EMT is operating too slowly to be part of modernisation (York and Rosa, 2003). At the same time there are increasing numbers of studies indicating that policy conforming to EMT has been developing quickly in parts of northern Europe and Japan and more slowly in some other nations. However, the countries using EMT policy are steadily influencing other nations' environmental policy style through world-trade agreements and other international treaties. It may be that EMT is a transitory theory or part of a continuum on the way to some other aspect of modernisation theory or perhaps a building block for another meta-theory. If EMT is viewed as a sub-set of modernisation theory this might reduce the pressure on it to perform as a fully functional theory, but it does not detract from its usefulness in identifying a change in the policy discourse within the environmental arena. It draws attention to important empirical shifts in social approaches to environmental issues.

3.2.4 Use and limitations of EMT in this study

Although EMT has not been applied to a research issue like this one, the actions conforming to EMT are considered in this research to be an effective guide for improved sustainability outcomes. Mol's (1999) four core features of EMT are deployed as a guide to interpret and analyse the narratives of the research participants. In the narratives, participants express their views on aspects of these four core features and how they have been applied (e.g. views on science and technology, economic development, state intervention and environmental NGOs). The participants' views are then used to critique the effectiveness of the state's policy, the Green NGOs' lobbying and support and the suitability and the marketability of the innovation for industry. The degree of democratic collaboration and effective communication between each of the core elements of EMT that are able to assist industry to reform its practices are also critiqued.

EMT was useful for discerning strengths and weaknesses in policy development and in the innovation itself. However, EMT was limited as an analytical guide in this study for the following reasons. Firstly, EMT can indicate the sustainability of an innovation for industry, but it does not provide a framework for understanding the construction of scientific knowledge that underpins a recommended innovation. Secondly, despite the rejection by growers of the recommended innovation, government policy sought regulatory means to enforce the adoption of the innovation. An EMT framework cannot provide insights into the power relations that influence policy development in this particular study. Instead, Foucauldian theory provides for insights into the contested scientific knowledge underpinning the innovation (recommended practice) and the power relations involved in describing and addressing the 'problem' of soil and nutrient run-off to the Great Barrier Reef. Part two of this chapter describes how

Foucauldian theoretical concepts are used to interpret the participants' narratives and shed light on underlying reasons for growers' resistance to adoption of the recommended practice.

3.3 Part Two – A View Through a Foucauldian Lens

Michel Foucault is a key post-structuralist thinker whose work is important to many scholars interested in the dynamics of the environment movement. This part of the chapter outlines Foucault's concepts that provide critical insights into the contested knowledges that influence the development and reception of environmental innovations. Foucault's concept of ecogovernmentality provides a particularly useful framework for understanding the power relations influencing environmental policy in this study.

3.3.1 Introduction to some key Foucauldian concepts

Post-structuralist analyses tend to be sensitive to issues of power, as they examine the way we construct the world through different ideologies that compete for dominance or hegemony. Foucauldian concepts such as power/knowledge, discourse and governmentality are elaborated here to show how different types of knowledge are constructed, acknowledged and/or dismissed in the development of environmental policy.

3.3.2 Foucault's knowledge/power nexus

Foucault presents the notion of knowledge/power as a single term to epitomise the inextricable links between 'power' and 'knowledge' (Foucault, 1984a, 1991a). He outlines a theory of power that understands power as more collaborative than oppressive, stressing that the more people that accept particular views associated with a belief system as common knowledge, the more these belief systems gain momentum and power. Belief systems are validated and supported by their associated figures of authority, such as medical doctors, priests or scientists (Foucault, 1991d). Foucault claimed that knowledge linked to power not only assumes the authority of 'the truth' but has the power to make itself true because the discourse is associated with a belief system that constructs and reinforces ideas about what is correct or incorrect until these ideas *become* truths. Similarly, Foucault's concepts expose ways that truth is based on evidence that can be criticised and destroyed (Foucault, 1991d).

Many scholars writing in the social sciences and humanities accept that there is no absolute truth, and that reality is socially constructed. Instead, we rely on multiple sets of knowledge as (partial) interpretations of reality. Specialists or experts who provide advice come with their

own interpretations of knowledge, which are in turn based on prior assumptions, expectations, experience of reality and notions of validity. Consequently, our concept of reality is shaped by these experts' prior assumptions, expectations and experience. As a result, knowledge can no longer be perceived as an objective and politically detached representation. Reality or truth and all knowledge claims are contestable (Foucault, 1991d).

Foucault's premise was that each society creates a regime of truth according to its beliefs, values and mores. He identified how truths are created in contemporary western society and summarised this in five statements: truth is centred on scientific discourse; truth is accountable to economic and political forces; the diffusion and consumption of truth occurs through societal apparatuses; the distribution of truth is shaped by political and economic apparatuses; and truth is the issue of political debate (Foucault, 1984b). He emphasised that 'truth' is the construct of the political and economic forces that command the majority of power in society. Of relevance to this thesis is how experts communicate their knowledge. In Foucault's terms, in order for these experts to communicate their knowledge they need to be connected to one of the truth-generating apparatuses or accepted knowledge communities of the society (also known as epistemic communities) (Foucault and Gordon, 1980; Foucault, 1984b).

3.3.3 Expert advice and epistemic communities

This thesis interrogates how Foucault's knowledge/power nexus shapes the governance of the environment. To understand this context we need to consider how our dependence on 'knowledge communities' or 'epistemic communities'[21] has surged in modern times especially since World War 2. Beck (1992a, 1992b) coined the term 'risk society' to describe modern western society's ever-increasing aversion to risk and consequent imperative to manage risks. Modern environmental problems have presented as complex risks since World War 2 because they tend to be phenomena that we cannot detect with our senses, for example, nuclear radiation, poisonous gases and chemicals, x-rays and ultraviolet radiation. Beck argued we are beholden to scientists and experts to identify and describe these risks, but we also rely on these same experts to provide advice on how to manage them. Scientific knowledge used to identify and describe environmental risks has a special kind of authority that makes it the most highly esteemed kind of knowledge used to guide decisions about natural resource management issues (Okasha, 2002). Science therefore plays a pivotal role in the identification and description of an

[21] A term coined by Haas, 1964; Haas 1989 and built on Foucault's use of the term 'epistemes' when referring to a particular body of knowledge or worldview. An 'epistemic community' is a network of professionals with recognised expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area (Haas, 1992b).

environmental problem and the resolution of environmental problems and disputes, even though science can be contested for its veracity (Kuhn, 1962; Latour, 1999 and Okasha, 2002).

Hannigan (1995) argues that a Foucauldian discursive approach helps us understand science as an environmental claim-making activity that constructs environmental risks. When complex environmental problems have proven difficult for citizens or government officials to grasp, we rely on scientific experts who better understand the details. Issue-centric experts from around the world communicate with each other and develop into an epistemic community, which literally translates as a knowledge society. The members of these communities share their ideas about an issue and devise solutions to problems. Because these experts have already discussed and agreed on ways of dealing with the problems amongst themselves, their collective consensus has a powerful influence on policy development (Hass, 1992a, 1992b).

Epistemic community members identify and translate risks and also interpret them. Each community member is influenced by their colleagues' views and further consolidates the aggregate or consensus views of the epistemic community. As all of the experts within the epistemic community reiterate the consensus view, they then tend to furnish decision-makers around the world with much the same information (Haas, 1992a). This has resulted in a knowledge society with unprecedented levels of power with regard to environmental policy development.

Adler and Haas (1992) discuss how epistemic communities influence the policy development process. First, epistemic communities gain power by framing the context of the issue and how it is to be interpreted. They then determine the norms and institutions to be involved in managing the issue. This has led to the development of new organisations entrusted to deal with the issue, which are populated with epistemic community members. Examples of these new organisations in the environmental domain include: Global Environmental Council (GEC), International Council of Scientific Unions (ICSU), International Geosphere Biosphere Project (IGBP), International Meteorological Institute (IMI), Intergovernmental Panel on Climate Change (IPCC), United Nations Conference on Environment and Development (UNCED), United Nations Environment Programme (UNEP), World Meteorological Organisation (WMO) and World Resources Institute (WRI), to name a few (Adler and Haas, 1992). Secondly, epistemic communities have helped decision makers to identify their interests and tactics for managing the problem through political avenues suggested by community members to expedite solutions (Adler and Haas, 1992). For example, epistemic communities have identified national interests for decision-makers in trade relations to influence the consumption of their domestic products

designed to prevent damage to the ozone layer as opposed to the alleged ozone depleting products of competing nations. Thirdly epistemic communities have set the standards and regulations to manage the issue. For example, it was the community of cetologists who devised the new management procedures and regulations concerning whale hunting (Adler and Haas, 1992).

The way that epistemic communities have diffused their policy advice nationally and transnationally has been through publications, communication with colleagues from scientific organisations and through conferences. Through these channels of communication epistemic community members alert decision-makers to an ecological issue, exert pressure on governments and then become the source of advice on the issue (Adler and Haas, 1992). Indeed Leach *et al.* (2007) argue that the last few decades of dealing with ecological issues has seen a shift from state-led government and planning to a dependence on advice gained through interactions and networks between multiple scientific experts and bureaucrats.

Epistemic communities are often relatively small (typically under thirty-five people) but to be successful must possess respected members who can influence those within their disciplines and ultimately bureaucrats and policy makers. Advice to decision makers from 'trusted' scientists wields greater power and influence (Carolan, 2006a, 2006b, 2006c, 2006d, 2006e; Carolan and Bell, 2003). The primary concern of an epistemic community is to exert political influence on collective decision-making (Hass, 1992a). While epistemic communities provide consensual knowledge, they do not necessarily generate truth. Through a consensus however they articulate reality and identify and represent issues of public concern. Sceptical comments made by scientists can only gain credence when an epistemic community has not yet achieved a consensus. The authority of an epistemic community thus remains powerful until it loses its consensus (Adler and Haas, 1992). Once the epistemic community's ideas become institutionalised they gain the status of orthodoxy and then persist and become largely irreversible (Haas, 1992a, 1992b).

Epistemic communities' ascendency of power can be linked to the emergence and growth of the environmental movement. Prior to this form of influence in the decision-making processes bureaucracies wielded power through knowledge and their direct access to governance of the state. Bureaucracies continue to derive power through knowledge and policy development, but epistemic communities now represent another layer of power that bureaucrats rely on for specialised knowledge and for the legitimisation of policy decisions. The next section discusses

how the link between epistemic communities and bureaucracies has shaped the system of governmentality.

3.3.4 Epistemic communities, bureaucracies and the State

Like Foucault, Weber (1978) also saw derivations of power through knowledge in bureaucracies. Bureaucracies are concerned with the business of administration: with controlling, managing and coordinating a complex series of tasks (Weber, 1978). Weber believed that bureaucracies had become the dominant institutions of all industrial societies. In order for bureaucracies to be effective as systems of control they required legitimacy. Bureaucratic officials gained power and dominance when they exercised the technical knowledge and expertise for which they were appointed. The use of expert knowledge, rational action and technical superiority provided a bureaucracy with legitimacy (Weber, 1978). Weber appreciated the advantage of a technically trained and knowledgeable bureaucracy. However, he was concerned about the dangers of bureaucratic control whereby bureaucrats dominated society through their administrative powers and could end up existing to serve bureaucracies rather than the politicians and societal values they were supposed to (Weber, 1978; Heckman 1983).

Professionalisation and expansion of bureaucracies[22] has developed along with the increasing reliance on technical and scientific expertise from epistemic communities to support policy decisions. Professionals from within bureaucracies or scientific institutions share the same norms, language, appreciation and understanding of each other's systems of knowledge, mores and communication styles, which further facilitates a trust between scientists and bureaucrats (Haas, 1992b). This is how strong links between bureaucracies and epistemic communities are co-produced and reinforced.

State bureaucracies act as rational and technically oriented organisations, and contain experts who communicate best with experts from other similar organisations. In this political arena of government or the state, 'knowledge' refers to the vast system of people, theories, understandings, projects, experiments, techniques, calculations, procedures, objectives, values

[22] In the United States, for example, the number of scientific and technical personnel employed by the federal government grew from 123,927 in 1954 to 189,491 in 1976 to 238,041 in 1983. This mere doubling of the number over nearly three decades obscures other pertinent changes in the individual expertise in U.S. government employees. From 1973 to 1983 alone, the proportion of scientists and engineers with doctoral degrees grew by 51 percent and the proportion with masters degrees grew by 44 percent. During the same period, the government was increasing its staff of scientists, engineers and computer specialists by 4 percent per year, while the increase for other personnel was only 2 percent per year. By 1983, scientists, engineers and computer specialists comprised 15 percent of the government white-collar work force in contrast to 13 percent in 1973 and in contrast to 6 percent of the non-government work force in 1983 (Hass, 1992b:9).

and ideas that has become such a central component of government. It is this knowledge system for managing people and things through the state that Foucault refers to as governmentality (Foucault, 1991b). Bureaucrats apply their knowledge and ways of knowing to the system of government and governmentality in their everyday activities. When bureaucrats work with experts to devise programs they apply a technical approach composed of norms, rules and processes that can be understood and managed by authorities (Rose and Miller, 1992). As a consequence, bureaucrats and experts – as the 'knowledge elite'[23] – have gained greater access to and power over the processes of policy development.

3.3.5 Ecogovernmentality

The term 'governmentality' is a neologism Foucault presented and explored at the end of the 1970s (Foucault, 1991a, 1991b,1991c). Foucault interrogated how a new form of political power emerged from the Enlightenment period whereby the state gained greater control and increased interventionism in order to manage a growing population and all of the responsibilities that entailed as part of a nation's economic well-being. This then led to the state's increasing concern with the biological well-being of the population, which included disease control and prevention, provision of adequate food, water supply and sanitary dwellings, access to education and so on. The new pastoral techniques meant that the 'shepherd' (once the church and now the state) 'took care' of the wellbeing of the population (Sairinen, 2002). Scholars working in the field of ecogovernmentality show how modern governance has seen this shepherding role extend to the management of environmental risks.

In the mid-1990s a small body of theorists comprising Darier (1995), Luke (1995a, 1995b, 1999) and Rutherford (1999) were interested in extending Foucault's concepts of governmentality into the arena of environmentalism and environmental studies. They applied Foucault's concepts of biopower and governmentality to understand how society was constructing and regulating the natural world. From this pursuit they derived the concept of ecogovernmentality. Ecogovernmentality, as a concept, aims to understand how government agencies, in combination with epistemic communities, construct the environment, define environmental problems and determine how they should be managed. Goldman (2001) argues that when the discovery, description and classification of a new environmental problem is created, individuals are then attributed as the cause of the problem and made responsible for changing their actions. The newly created subjectivities and environmental norms then determine the ways in which people should interact with nature. Goldman (2001) describes evidence of ecogovernmentality where specific groups of experts (epistemic communities) have

[23] A term coined by Dorothy Nelkin (1979).

managed to scientise, de-politicise and institutionalise notions of global environmentalism and citizenship and set standards and regulations while de-legitimising others. For example, Goldman (2001) elaborates how people in the Mekong region who were described and categorised as slash-and-burn cultivators by agents of the World Bank and then branded with blame, were forced by their fellow nationals to look for different livelihoods so as not to jeapordise the funding for regional infrastucture projects.

The dominant environmental discourse – in society in general and in this thesis in particular – is centred on the quest for sustainability. This discourse encourages us to believe that environmental problems can be dealt with by experts who break them down into component parts to be reordered and managed through technological means (Luke, 1995b). Seduced by this sort of expert advice the state has extended its shepherding role to fix these problems with a 'command and control' approach to environmental protection (Luke 1995b).

Discourses of sustainability rest on assumptions that nature can be regarded as 'normal', but nature is chaotic and much less 'normal' and predictable than scientists have thought (Luke, 1995b). Moreover, it is assumed that once the factors of nature have all been identified and tracked, then these variables can be monitored to manage the global ecosystem. Indeed, Luke (1995b) argues that most of the sustainable development discourses espoused by ecocrats or ecoscientists suggest they believe they can monitor and protect global environmental processes while successfully achieving national plans for economic development. Alternatively, attempts to govern nature are essentially more about politics than scientific expertise. Organisations like the Worldwatch Institute construct nature and methods of scientific surveillance and then advise on how nature should be governed. This is an example of ecogovernmentality in action. The discourses of World-watching institutions produce a self-sustaining system that is perpetuated and legitimated by powerful expert and bureaucrat members of this elite epistemic community (Luke, 1995b).

A number of analysts have argued that an understanding of the way in which knowledge is transferred into governance has been surprisingly absent in much contemporary mainstream thinking and practice in governance, politics and policy processes (Fischer, 2000, 2003; Jasanoff and Wynne, 1997; Keeley and Scoones, 1999, 2003). This is despite the work on epistemic communities by Haas (1989, 1992a, 1992b), Adler and Haas (1992) and Fairhead and Leach (2000, 2003a, 2003b). Many of the scholars writing in the field of ecogovernmentality are concerned about the subjugation of local knowledge and the economic consequences this has on the local people and their livelihoods along with the unintended outcomes that can

degrade the local environment even more. Scholars such as Leach *et al.* (2007) have posed key questions about the ways that evidence has been applied in the political process; how evidence was constructed in the first place; by whom; and in relation to what conceptualisations of the world and through what social commitments. These authors demonstrate a particular interest in the ways that certain types of knowledge gain power and dominate over others; and the subsequent affect this has on the local people and their livelihoods.

3.3.6 Undervaluing local (regional) knowledge

A feature of ecogovernmentality is the undervaluing or subjugation of local or rural people's knowledge (Thompson and Scoones, 1994). The knowledge of local people is often undervalued as it lacks the authority of scientific language, which is an important part of the dominant discourse. As a consequence, local knowledge is often ignored or undervalued and therefore is rarely heard. The undervaluing of local or regional knowledge constitutes the subjugation of that knowledge.

'The environment' has become a dominant concern in both developed and developing nations. The way that environmental issues have been constructed and managed by international epistemic communities in developing nations invites critical analyses. This section reviews two studies of the subjugation of local and regional knowledge in international settings: those of Fairhead and Leach (1996, 2000, 2003a, 2003b) and Goldman (2001), who are leading researchers in this field. Those reviews are followed by a review of the studies by Allan (2005), Glyde and Vanclay (1996) and Higgins *et al*. (2001), which concern subjugation of local knowledge in Australian farming industries. The aim of this section is to connect the social, economic and environmental consequences of ecogovernmentality in which those in power no longer hear the voices of the local people. These concepts inform my interpretations and analysis of the discourse of participants in the Australian sugar industry, and provide a better understanding of growers' resistance to the adoption of the recommended fertiliser practices.

Leach *et al.* (2007) studied the politics of knowledge through the domination of conservation and development policy, mainly directed by certain disciplines such as conservation biology. They have discussed how the epistemic communities of these disciplines influenced international perspectives and critical debate to facilitate the use of highly coercive practices on the local people in developing nations. In particular, Fairhead and Leach (2000, 2003a) researched the social and political dimensions of the international management of vegetation in Guinea's Kissidougou prefecture in West Africa. They examine the contrast between the way that the problems of vegetation management are constructed by international experts compared

to the views and conduct of the villagers' vegetation management activities, which had become subjugated and criminalised within the policy formulation.

Fairhead and Leach (2000, 2003a) identify conditions in which certain demonstrably false ideas about the vegetation and its management had come to acquire validity in policy circles, while the views espoused by the local inhabitants had been excluded. Their study examines the discursive processes that condition the construction of the narratives that shape the knowledge produced about development problems, including the generation of data considered to be credible. Using their dominant methods of knowledge production, international experts determined the constructs and definitions of environmental degradation. As a result, it was no surprise that they were able to find abundant evidence to support their conviction (Fairhead and Leach, 2000).

Even more concerning are the cases where actors falsify data used to measure environmental changes that are then used as the basis for policy development (Fairhead and Leach 2000, 2003a). These studies have revealed major differences between international experts' perspectives and knowledges and the local peoples' perspectives and knowledges. Fairhead and Leach's study concerned reported transformation of tropical forest to savanna, which as it turned out was not actually occurring. Scientific reports of degradation in Kissidougou were not a result of ignorance, but rather of the prior and continued production of knowledge that the researchers brought with them (Fairhead and Leach, 2000). Because these researchers belonged to epistemic communities through which they exercised power then *their* way of collecting and organising data was continually reaffirmed. Simultaneously, the local peoples' methods and data sets had been disqualified as inadequate, naive or unscientific in comparison to the scientifically supported methods that brought with them the effect of authority and certainty (Fairhead and Leach, 2000).

The experts involved in conservation sciences (especially conservation biology) are often the same experts who identify the environmental risks and decide if the issue is an environmental crisis (Beck, 1992a, 1992b; Crichton, 2005). These experts see the world through the lenses and filters that come with their own values and prior understandings. Then they bring this 'already knowing' as an overlay through which they view the world. Scientists present their findings to bureaucrats and policy makers in a tidy manner that spares the details about uncertainties or assumptions, thereby 'black-boxing' them away from further scrutiny. Debates about the way the science is conducted then raise questions of material and social control and the contestation of 'expert' science (Fairhead and Leach, 2000, 2003b).

The second study I review is that of Goldman (2001), which focused on new global regulatory regimes to manage the environment through interventions made by the World Bank. His study in the Mekong region depicts how the construction of transnationalised environmental states in tandem with evolving governmentality in the Foucaludian sense, created new dimensions of eco-power. Goldman argued that the World Bank's new discourses of ecological improvement compelled the people in the Mekong region to participate in the process of co-producing ecogovernmentality. He argued that the resource-rich and capital-poor borrowing countries such as Laos experience transformations in the management of their natural wealth and natural social relations through the proliferation of eco-scientific and eco-political processes in the name of environmentally sustainable development (ESD). Goldman proposed that instead of ESD it should be renamed *green neoliberalism* because the World Bank was using its immense economic influence and power to foster the scientisation, governmentalisation, and capitalisation of some very hotly contested eco-zones such as the Mekong region and the Amazon. As a result, the power exerted by the World Bank caused the subjugation of the local knowledge of rural land management practices. Goldman (2001) asserts that as the scientific, regulatory, and legal frameworks emerging from forays into international development programs become institutionalised, then we should critically inquire into how these imposed systems of 'ecological improvement' come into being. He also suggests further research into the ways in which these particular regimes of truth gain authority over the local peoples' understandings and experience, causing them to become subjugated to the dominant and powerful epistemic communities.

In contrast to the international examples above taken from developing nations, there are some Australian examples of studies of how farmers' knowledge becomes subjugated. Allan (2005) explores how farmers learn and construct knowledge and notes that scientists become frustrated by the lack of uptake or adoption of new practices that *they* thought were necessary for good farming practice. The resistance farmers demonstrate to the adoption of some recommended practices is often seen by scientists and bureaucrats as an uneducated and ignorant response. From the perspectives of the farmers, they *knew* that the practice or new technology would not fit their particular local situations. Allan (2005) notes that this difference in views led to a division between the scientists and farmers. She also found that a farmer's tacit knowledge was often not recognised by scientists as valid or real, but more often was considered as ignorant, wrong or unscientific. In contrast, Allan had come to recognise farmers and farming as a well-developed knowledge-based industry even though it was not commonly recognised or authenticated as such by experts. Allan also discovered that experts were credited with authority and respect from the farmers when their knowledge was consistent with the local values they

were appealing to. Conflicts arose when outsider experts tried to convince farmers to adopt practices that demonstrated an ignorance of farmer's needs or ran counter to the farmer's culture.

Armed with the language of rationality and truth, expert knowledges seek to influence individuals by offering techniques for managing properties more prudently. The values and beliefs of experts are different to those of farmers, yet experts are asking farmers to realign their values with their own. Higgins *et al.* (2001) observe that the success of science-based disciplines rests on the re-shaping of local peoples' knowledges and practices to conform with the dominant rules and norms of science – not forgetting that the success of the expert knowledge or advice also rests on the assumption that it is valid. In the Higgins *et al.* (2001) study of Australian cotton growers versus the experts, growers had come up with their own trials and evidence for drip irrigation but experts already had their own ideas of what constituted best management practice. It was the experts who wielded the governmental power and the growers failed to influence them otherwise. The cotton growers' attempts to define and influence research programs were de-legitimised when their understandings of industry best practice did not align with dominant knowledge and priorities of the researchers. The cotton growers did not dispute the role of science in the improvement of farming practices, only the research priorities of the agri-science agencies and institutions. The study pointed to the bureaucratic-expert alliance of knowledge (or epistemic community) that wielded the power (Higgins *et al.*, 2001).

In another Australian example of the subjugation of local farmers' knowledge and their farming practices Glyde and Vanclay (1996) examined the adoption of a computer-based decision support system designed for grape growers where some unpredicted resistance emerged. Glyde and Vanclay (1996) found the barriers to adoption were not due to grape growers' lack of experience or comfort in the use of computers. Instead the main barrier was that grape growers believed that the best way to make their management decisions about the crop was not from sitting in an office using computer modelling but rather from first hand experience in the field. In the study's concluding remarks the authors emphasise that this was yet another case whereby the agricultural scientists had assumed that their new technology would be received automatically as beneficial to the grape growers. In their normative scientific view, those who developed the technology had assumed that grape growers needed more complete information to make better management decisions and that they would favour this style of technological management to control pests and diseases. However, the scientists failed to recognise that adoption of this management practice would consequently subordinate all other sources of

information that the grape growers used to manage their crops, including their own experience and knowledge. This technology was simply not congruent with the growers' farming knowledges and values (Glyde and Vanclay, 1996) and yet the techno-scientists prevailed yet again over the advice of the socially-informed researchers. The authors were not surprised given the dominant techno-scientific history of research in viticulture and the genuine beliefs and convictions of the researchers that they were operating in the best interests of the industry. Yet again a considerable amount of public funding was used to try and influence farmers' methods of conducting agriculture, rather than in asking them first what their needs were (Glyde and Vanclay, 1996).

The various studies listed above provide examples of the ways that local or regional farmer knowledges tend to be subjugated to the dominant policy imperatives. Some of the examples above also provide cases of expert knowledge being inaccurate or wrong. In the quest for more sustainable farming it is not the intention of experts and bureaucrats to extinguish a farming industry or harm farmer livelihoods. This can often result, however, in misplaced expenditures or costly inappropriate changes to practices. The challenge thus remains to find better ways of providing a voice for farmers' knowledges, experiences and understandings in a manner whereby they can be heard, appreciated and included in environmental management decisions.

3.3.7 Conclusions

Foucauldian conceptual framing enables an analysis of the underlying discourses that are applicable to the problem of sugarcane growers' resistance to adoption of the recommended fertiliser practice. It also enables an identification of the members of the epistemic communities that wield power. The use of this theoretical framework can provide insights into the assumptions that direct the way people act and the kinds of knowledge and concepts upon which people draw to make decisions. More of this will be discussed in greater detail in subsequent chapters.

3.4 Combining EMT and Ecogovernmentality

Two distinct sets of theoretical concepts are used in this thesis to provide insights into the reasons why so many sugarcane growers in the Wet Tropics have resisted the adoption of recommended fertiliser application rates. EMT and its tenets provide a framework for analysing how effective government policy has been. A Foucauldian framework enables the analysis of

discourses of power and knowledge that shape the governance of sugarcane farming in Far North Queensland. Used separately and together in a novel way, these two theoretical frameworks became much more than the sum of their parts. Deeper insights were gained into the political, social and economic influences exerted to tackle environmental problems than if either approach had been used alone. A more detailed elaboration of these conceptual framings will unfold in the analysis that follows. In the next chapter I describe the methodology selected to accomplish the research.

Chapter 4 Methodology

4.1 Justification of the methodology

This chapter presents the methodology used for the research. As outlined in Chapter One, the research set out to examine why sugarcane growers were resisting the adoption of recommended fertiliser practices. Mills were assumed to play an important role in influencing growers' choices of cultivation practices; they might be directly or indirectly persuading growers to avoid practices that result in reduced income and profitability. EMT was selected as a framework to analyse the role of industry, and mills in particular, in impeding the adoption of recommended fertiliser rates. As outlined in Chapter Three, EMT provides a set of conceptual tools for exploring reasons why industry adopts or resists a recommended ecological practice. It also helps analyse the effectiveness of an innovation/recommendation and associated policy measures designed to support industry to be more sustainable. In-depth interviews were selected as the method of gaining insights into this world of policy making and grower resistance. Interviews enable participants to express all the complexities and contradictions of their thoughts and actions through a dialogue mode that is particularly suited to this research context (Dunn, 2005). As discussed in more detail below, growers and key people from the sugar industry were interviewed along with key people involved in developing or delivering reef protection policy.

Chapter Two established that growers have a history of readily adopting recommended practices, with the best example being their uptake of Green Cane Trash Blanketing (GCTB). The recent resistance shown by growers to recommended fertiliser practices signaled an important change in the relationship between scientists and growers. The EMT analysis provided useful insights into reasons why the industry was averse to the recommended practice, but did not provide a way of explaining the often opposing views and distinct knowledges of the participants. A Foucauldian theoretical framework provided supplementary conceptual tools for interrogating the discourses and technologies of knowledge/power relations, which so clearly framed the issue. Foucauldian perspectives help discern the perceptions and biases of the sugar industry, scientific experts and bureaucrats, and interrogate how they frame both the current health and future protection of the GBR. This chapter describes the methods used as well and how the research unfolded.

4.2 Method

4.2.1 Interview methods and selection of participants

Individual interviews are probably the most widely used method in qualitative research. They provide an opportunity for a detailed investigation of peoples' personal perspectives, an in-depth understanding of the personal context within which the research phenomena are located and provide a very detailed subject coverage. Individual interviews are also well suited to research that requires an understanding of deeply rooted or delicate responses to complex systems and experiences because of the depth of investigation they offer (Ritchie and Lewis, 2003). Studies of barriers to the adoption of recommended practices have likewise stressed the role for qualitative methods. Although quantitative research can identify barriers at a global level (such as awareness, access, cost, convenience and applicability) it is less able to explain the intricate motivations for the uptake of, or resistance to, a recommended practice (Ritchie and Lewis, 2003).

Interviews are especially useful for qualitative research with farming communities in Australia as the people who work in farming industries in Australia form close-knit groups and generally tend to be media-averse, modest and careful to keep their opinions to themselves. When asked questions about their opinions on certain matters they will often avoid a direct answer in an attempt to avoid 'rocking the boat'. Questions put to sugar industry personnel about matters that could be deemed controversial during a relatively brief encounter would not solicit an open conversation based on trust. This is particularly the case when the person posing the questions works for an organisation that is viewed as hostile to the interests of the industry. To be effective, the interviews used in this study needed to be individual, anonymous, in-depth and semi-structured. One-on-one interviews held in the participants' homes or offices, for a sufficient length of time, were undertaken to develop a background of trust and open dialogue. Preferred participants were those considered to be key people in representing the industry and reef protection perspectives. The interview process was considered the best way to elicit the underlying views and understandings of participants that affected adoption of the innovation.

A case study approach was used for data collection (Stake, 2000; Yin, 1998). The research involved in-depth, semi-structured interviews with growers from two small sugar industry localities in the Wet Tropics: Mossman and Tully (refer to Figure 1). These two localities were chosen as they had dissimilar situations both economically and geographically which might have had an effect on industry participants' responses. Other participants who worked in the sugar industry were also interviewed, along with bureaucrats, agricultural and environmental

scientists, extension officers, tourism operators and Green NGO staff with input into environmental policy decisions about growers' practices (refer to Appendix 8 for Participant Details).

Criterion-based or purposive sampling was used as the approach for selecting participants (Mason, 2002; Patton, 2002). Key people from each of the identified interest groups were invited to participate. People known to hold key industry positions were invited to participate, along with recommended referrals and others I had known from my own direct professional experience in working with the sugar industry, government agencies, local green groups and the tourism industry. All participants shared an interest in the social, economic and environmental aspects of the industry. The diversity of participants allowed for a diversity of views and perspectives, providing a rich data set for analysis (Taylor and Bogdan, 1998).

At the commencement of the research a major consideration was seeking representative growers from the Tully and Mossman mill areas. The sixteen growers interviewed from Mossman represented twenty per cent of the growers for that mill area, and the thirty growers interviewed from Tully represented twenty five per cent of the land area under sugarcane for that mill area. In retrospect it was unnecessary to interview so many growers for a qualitative study[24]. Half that number of grower interviews would have been sufficient for such an in-depth study (Perry, 1998), particularly since the themes emerging from the growers were recurrent.

[24] As an environmental scientist undertaking research that was qualitative and sociological (a new discipline) I was yet to come to understand how quickly saturation was reached and when further interviews failed to contribute new information (Taylor and Bogdan, 1998).

Table 4.1

Composition of Participants and Their Affiliation Codes[25]

Participants	Number
Pilot grower (PG)	3
Mossman grower (MG)	16
Tully grower (TG)	30
Sub-total of growers	**49**
Mill staff (IM)	8
Mill & BSES extension officer (IE)	2
Sugar Industry Association (IA)	3
Sub-total of other sugar industry employees	**13**
Government Scientist (GS)	5
Government policy maker (GP)	6
Government extension officer (GE)	4
Green NGO representative (GNGO)	3
Tourism representative (T)	2
Sub-total of 'interested' non-industry employees	**20**
TOTAL	**82**

All of the participants were initially contacted by telephone to ask them to participate in this study (many of whom I already knew through prior professional interactions). Other participants were sought through a notice in the Sugar Research Development Corporation newsletter and through a presentation I made at the Tully Productivity Board award ceremony. Some of the participants were contacted via recommendations from sugar industry extension officers who could recommend growers from the range of attributes that might influence their perceptions such as their sex, age, range of income sources and size of their farms. For more detailed information on participants see Appendix 8. During an initial telephone conversation the aims and focus of the study were explained along with an outline of what the interview would involve. A suitable time and place for an interview was then organised with those who agreed to be part of the study.

[25] The letters at the end of each category refer to the code used to identify the participants when they are quoted in later chapters. Appendix 8: Participant Details, provides a more detailed description of the participants interviewed in this study.

4.2.2 Ethical considerations

Informed consent was vital for this study and consent forms were utilised prior to the commencement of each interview. In order to protect participants' anonymity codes were assigned to each participant so that their words would not identify them when results were published. Ethics approval for this study was obtained as required from James Cook University Ethics Review Committee and given the clearance number H2403 (refer to Appendix 7 for a copy of the Ethics Approval). All audio recordings and transcripts have been secured on my laptop and backed up to an external hard drive that will be retained for five years upon completion of this study, and then destroyed.

4.2.3 Interview structure and process

Pilot interviews were initially conducted with three sugarcane growers (and their wives) from the Mulgrave mill area (located in and around the city of Cairns and Gordonvale) to test which questions needed to be deleted, added, rephrased, or emphasised in two or more different ways in order to encourage respondents to be more explicit about their views. The interviews were conducted in a comfortable environment, either at the participant's farm home or office. All participants were provided with an Information Page (refer to Appendix 5) containing details of the research for their records and for contacting the university ethics officer in case there were concerns about the conduct of the researcher.[26] Prior to the commencement of the interview, participants were then asked to read and sign an informed consent form (refer to Appendix 6) that also assured strict confidentiality and anonymity.[27]

The participants were asked to allow 90 minutes for a single interview, but a time limit was not enforced by the researcher where participants were willing to discuss a topic further. Because the interviews were semi-structured this allowed for some flexibility while maintaining focus on the main topics. Even though prepared questions were used as a guide (refer to Appendix 4 for Interview Guides for Growers, Industry Members and Industry Stakeholders), the sequence of questioning was made flexible in order to probe for further information or to skip sections that had already been covered. This flexibility allowed participants to discuss what they considered to be the most important issues or raise additional themes related to the topic. All of the interviews were recorded with the participants' signed consent and the interviews were then transcribed.

[26] See Appendix 5: Information Page for participants.
[27] See Appendix 6: Informed Consent Form for participants

The interview guide used was varied slightly between growers to ensure adequate background information was sought about the grower and his or her family and farming history, the property's history and their understanding and knowledge with regard to the cultivation practices they applied. This section was designed to find out as much as possible about each grower to ascertain if any differences in perceptions could be attributed to age, gender, ethnicity, history of farming, mix of income sources or any other attributes. This first section also provided an opportunity for the grower to ease into the interview and for me to establish my credibility as a non-partisan researcher (Thompson, 2000). This process proved valuable in developing the relationship between the growers and the researcher and in facilitating growers to speak their mind.

Appendix 4 contains the interview guides for all participants[28] and contains an additional section for non-growers where variations were made to the questions according to the role of the participant. Each interview began with questions about the participants' background and their involvement in or with the sugar industry, including what they saw as the main issues and reasons why so many growers were not adopting the recommended fertiliser application rates. The responses to these questions demonstrated the varying contexts of the Reef Protection participants' experiences with growers and how this affected their perceptions of them. The final part of the interview process focused on capturing participant's perceptions of any other processes that they believed were causing barriers to adoption of recommended environmental practices.

The second section of the interview process was much the same for all respondents. The questions in the second section focused on participants' perceptions about the sugar industry's environmental performance, growers' response to and uptake of recommended practices, the impact of the Reef Plan on growers, the role of regional mills, the influence of the industry structure on cultivation practices and the future of sugarcane growing in the Wet Tropics. Most respondents were very expressive and opened up to elaborate on their views and concerns. The study became more iterative during the exploration of participants' perceptions as the interview process proceeded over a period of twelve months from January until December 2007. The participants' responses in each interview provided rich data on perceptions held by sugar industry representatives and those participants who influenced environmental policy affecting the sugar industry. The perceptions that were held by each of the participants and their sphere of influence on environmental policy pointed to important social and political processes.

[28] See Appendix 4: Interview guides for each group of participants.

4.3 Management of data

4.3.1 Using themes to sort then analyse data

A thematic analysis was used in this study to sort, manage and analyse the data. It is a common approach to analysing qualitative data (Ritchie and Lewis, 2003). Through listening to the audiotapes and reading and re-reading the transcriptions, key words and phrases were identified and then themes were associated with these key words. Thematic analysis provided an effective way of collecting and sorting the words and phrases used by participants in context, coupled with observations made of the participants during the interviews, in order to examine and interpret the language spoken for patterns of meaning. Some themes were identified during the data collection phase while others emerged from the analysis of the transcripts. After the interviews were transcribed, the data were organised according to these themes[29], using the software tool NVivo (Bazeley, 2007; Bazeley and Richards, 2000; Gibbs, 2002; Ritchie and Lewis, 2003). NVivo encourages the use of themes and sub-themes to organise and store the data, however, NVivo is not limited to themes. It can be used to search for a term, phrase, or topic to allow the researcher to easily follow a lead or line of enquiry (Bazeley, 2007; Bazeley and Richards, 2000). This systematic sorting of the data helped to organise, access and securely store and make sense of the data (Bazeley, 2007; Bazeley and Richards, 2000; Gibbs, 2002; Ritchie and Lewis, 2003). A thematic system also helped to organise the writing process and facilitate the analysis of the data as each of the themes were considered within the context of the theoretical framework.

This phase of the research revealed the dominance of certain views within particular groups of participants. Growers' views were very similar within the grower group and somewhat different to those of the other sugar industry participants. Moreover, as the research progressed, it became evident there were two main groups expressing opposing views. The participants who worked for the sugar industry shared a similar language and world-view, while the participants who comprised the Reef Protection experts and policy makers, Green NGOs and others who did not work in the sugar industry shared a different language and world-view that contrasted with that of the industry group. Participants placed similar importance on shared views according to the group they identified with. The two main groups of participants were distinguished by calling them the Sugar Industry Group and the Reef Protection Group.

The themes that emerged from the participants were: Sustainability; Growers and Farming; Science, Technology and Expert Advice; Government; Mills; Green NGOs; Regulation; and

[29] See Appendix 9: Themes that emerged through the data analysis.

Grower Adoption. The two main groups of participants had opposing views within each of the themes. These views were summarised and grouped into tables, which provided useful guides for distinguishing differences and honing the process of interpreting their views to gain an understanding of how they were constructed and why they conflicted (refer to Appendix 9 for Themes that emerged through the interview process and data analysis).

The themes that emerged from participants' words and phrases supported an EMT analysis. More specifically, participants' views situated them with regard to views about the effectiveness of Mol's core features (outlined in Chapter Three) and were used to reveal some of the barriers to adoption. When applied to the subject under study, Mol's core features could be stated as:

- the suitability of the innovation and the science supporting it;
- the people comprising the sugar industry and their level of commitment to the ecological sustainability of the industry;
- the context, design method, authorship and execution of policy; and
- the level to which Green NGOs work with industry to support sustainable policy outcomes for the environment and industry.

The views of the participants in relation to Mol's core features were used to reveal some of the barriers to adoption. Later, as underlying barriers emerged, Foucaludian theoretical concepts studied through discourse analysis formed the framework for understanding how the subjugation of industry views had come about.

4.4 Discourse Analysis

The research could have been completed from the interpretations and explanations developed from the EMT analysis but the rich data set begged examination from a different perspective. Further analysis was undertaken to understand how the struggle between the two main groups was constructed in the first place and why it took the course that it did. While the methods used for this study did not include recording shed meetings with growers, industry workshops or GBR water quality conference presentations certain scenarios and anecdotes from those events provided important insights to the relationship of language and power. In these instances certain views were privileged over others and discourse analysis helps interrogate whose views came to

dominate in debate about environmental protection. As suggested by Fairclough (2001), this kind of analysis provides a level of detail necessary to interrogate the discourses and contexts of knowledge/power relationships that shape people's actions (see also van Kreiken, *et al.*, 2000). Indeed, discourse analysis stresses the importance of persuasive language and how it attaches to persons of authority, which then helps to explain why particular constructions come to dominate. Thus the interview process provided an excellent context for examining contested knowledges. When combined with scenarios and anecdotes, the language used in the interviews provided a rich source of data.

Analysis of the themes and discourses that emerged from the interviews revealed how experts regarded the sugarcane growers and their industry; how growers and other industry members regarded the experts; and how the environmental problem, and its management, were constructed by all groups. Foucault's discourse analysis provides a lens through which to analyse this state of affairs. Foucault's understanding of the relationship between power and knowledge as studied through discourse analysis provides key insights to understand how the innovation, despite its failings from an EMT perspective, eventually became enforced upon growers.

Discourse analysis makes connections between the language used in conversation and the language used in social institutions and societies. In this form of analysis, meaning in the language can be found in the discourses in which the interviewees are immersed (Fairclough, 2001). Deconstructive analysis can also call for the researcher to 'read between the lines' (Sarup, 1993). Through listening to the audio recordings of the interviews and then reading and rereading the transcripts the researcher must constantly reflect on how language was used and how it has constructed discourses that sustained certain practices of knowledge and power. Numerous quotations from participants' interviews are therefore included throughout the analysis to substantiate the argument.

4.4.1 Situational context affects interpretation and explanation

A final note about situational context must be made to conclude this methodology section. Prior to the commencement of this research I developed water quality policy for the Queensland Environmental Protection Agency (QEPA)[30] and was QEPA's Sugar Industry Liaison Officer (SILO) involved in the development of Water Quality Improvement Plans (WQIP) for local shires in the far northern region of Australia. In the course of my previous work and this current

[30] QEPA is now known as Department of Environment and Heritage Protection (DEHP).

study I examined many documents sourced from scientific institutions, research organisations, the sugar industry and government policy. Normal practice for WQ policy development included input from experts working for GBRMPA, AIMS, ACTFR and CSIRO with regard to water quality management in the Wet Tropical Coast region. Many of these experts then became colleagues and social acquaintances. I became professionally, socially and ideologically immersed in the discourse that the health of the GBR was compromised and threatened by nutrient and sediment run-off and the recommended measures to protect it. However, as the SILO, I had also developed regional knowledge and understanding of the sugar industry and good connections with many of the industry's key people.

Interpreters commence research with assumptions about the context, which then influences the way in which the language in the transcripts is analysed. Not only are participants embedded within a situational context, so is the researcher (Fairclough, 2001). In the process of interpretation the analyst makes explicit the dependence of discourse practice on 'commonsense' assumptions for participants and benefits from being self-conscious in order to avoid importing untheorised assumptions. Due to my professional position prior to commencing this study, I arrived with assumptions and understandings that became evident during the course of the study. Where appropriate, throughout the thesis, I highlight when and how these views transformed.

Chapter 5 Regulating Sugarcane: An EMT Analysis

5.1 Introduction

This chapter examines the regulations of the sugar industry and associated grower adoption of recommended practices through an EMT policy analysis. It draws on participants' views of the effectiveness of government policy as well as my own environmental policy development history of attempts to manage and regulate the sugar industry. As described in Chapter Four, key themes identified from the interviews were: Science, Technology and Expert Advice; Growers and Farming; Government; Mills; Green NGOs; Sustainability; Regulations; and Grower Adoption. Grower Adoption, Regulation and Mills are the themes that pertain most closely to the regulation of the sugarcane industry. Industry participants had different views to Reef Protection participants about the practices that growers should adopt, as well as the means by which growers could be encouraged or forced to adopt certain practices. This chapter focuses on the analysis of these themes from an EMT perspective, while the next chapter focuses on a discussion of the ecological modernisation of the sugar industry. The remaining themes will be analysed in Chapter Seven.

The analysis presented in this chapter helps to explicate how the growers and various stakeholders understand the regulation and management of the sugarcane industry. For each theme the consistently different views of the two groups of participants are highlighted. Each group's position reflects different understandings and values, and the analysis suggests the Reef Protection Group perspectives dominate the policy field. But this chapter also selects excerpts from interviews to illustrate the opposing views and to let the participants speak for themselves as much as possible (Gibbs, 2002; Ritchie and Lewis, 2003). EMT provides a framework for critically examining the effectiveness of policy design and its application, and this chapter demonstrates that unless the government facilitates policy design that provides a win-win outcome for both industry and environment then the outcome will neither be sustainable nor 'ecologically modern'.

5.2 Perspectives on regulations

EMT usually considers the use of regulations as a last resort. In EMT a scientific or technological innovation is sustainable when it is cost effective and improves profits (or, at the least, does not impede them) and is welcomed by an industry for the market edge it can provide for their products. In other words, an effective innovation provides a win/win result both

ecologically and economically and is thereby considered sustainable *and* welcomed by industry. Regulation, in contrast, tends to be applied when other methods of encouraging industry to adopt environmental policy measures have failed. Resorting to regulatory instruments puts into question the effectiveness of environmental policy. Given the lack of uptake by sugarcane growers EMT led me to ask how the policy itself – rather than the industry – might be to blame (see Goldman, 2001; Jasanoff, 1990, 1996; Jasanoff and Wynne, 1997; Wynne, 1992a, 1992b).

During the course of this research scientists and Green NGOs involved in reef protection were advocating a proposal to regulate fertiliser use in the sugar industry[31]. This section examines diverse views regarding proposed regulations that were designed to force growers to alter their fertiliser regimes. Both Industry and Reef Protection Groups have different interpretations of the quality and validity of the science that influences the development of regulations and the effectiveness of regulations in general. These views are represented in Table 5.1.

Table 5.1

Summary of Participants' Views on Regulations.

Regulations	
Sugar Industry Views	**Reef Protection Views**
More and more regulations, so why bother to continue farming? Makes farming more costly.	Farming is exempt from the EP Act. Therefore need special regulations to force them to comply (with recommendations).
Regulations just make 'them' feel better. They do not fix anything because we are not damaging the GBR.	We tried explaining the science and showed them the statistics/evidence on the damage they cause and provided them with scientific advice on how to manage the problem – but they won't listen. Need regulations.
They tell us how to use fertilisers but it is not their land or their livelihoods. They don't have to bear the consequences of getting it wrong.	Need to bring fertiliser companies on board to help us manage how much fertilisers growers use.
Less fertiliser equals less volume of crop, so we lose income, but there is no compensation.	Growers need to use less fertilisers to protect the environment and they will save money and still grow a good crop.

[31] Prior to submission of this research the proposed regulations were made passed by parliament.

The Reef Protection Group views focused on the need to introduce regulations to enforce grower adoption of the recommended practice in order to manage the environmental problem, and because growers were not willingly adopting the practice. The Reef Protection Group participants were also convinced of the additional cost saving benefits from adopting the innovation. In contrast, the Industry Group participants did not believe that their actions were causing the environmental problem, and reduced fertiliser use was perceived as a threat to their crop volume and income. The next section explores the basis of each group's beliefs and understandings regarding the regulation of fertiliser use.

5.2.1 Sugar Industry and Reef Protection Perspectives

Interviews with participants from the Reef Protection Group revealed that most felt it was necessary to introduce regulations that would force growers to comply with recommended fertiliser rates. This was one of the greatest sources of tension and division between the Industry and the Reef Protection Group participants. The majority of growers strongly disagreed with the introduction of regulations regarding fertiliser usage. These quotes show some of the fears that growers experienced about the introduction of more regulations.

> There's a need for regulations, but there are over-regulations too where you get to the point where you need a permit to apply herbicides, you need a permit to start putting fertiliser down, you've got to get an environmental impact statement to say that your farming practice that you're about to do isn't going to impact on the reef. You have to jump through hoops and fill in paperwork just to do the smallest thing on your farm.
>
> (Mossman Grower 6).

> I don't know if they're going to be good regulations, but I think there definitely will be [more regulations]. I just hope that they do it in a way that we can actually keep farming and that they don't make it so hard that it's not going to be achievable.
>
> (Mossman Grower 15).

At the mention of possible new regulations to manage fertiliser usage, some growers voiced frustration about government neglect. Most felt that government was now more interested in the concerns of Great Barrier Reef Marine Park Authority (GBRMPA) than the concerns and needs for the viability of farming industries. Two grower participants expressed their fears that government did not value the future of farming along the coast in the Wet Tropics region.

> We've got the Great Barrier Reef [Marine Park Authority] out there and I think they have a lot more easy leverage with the government. You've got people down south saying the cane growers are destroying our reef. They think, 'we've got to protect the reef, get rid of the farmers'.
>
> (Mossman Grower 6).

> … As long as the Government hasn't got a plan there, a long-term plan to get rid of farming altogether on this red belt, so the Barrier Reef will stay.
>
> (Tully Grower 25).

An additional common concern expressed by grower participants was the potential for even greater costs to be borne by farmers when new environmental regulations were introduced. Growers were already required by law to control weeds and pests on their properties at their own expense. This Mossman grower expressed his concern about the issue of chemicals that were 'taken away' from them, sometimes with no substitute replacements and often with the added cost of being forced to use more expensive replacement chemicals that were sometimes less effective.

> I don't mind if every time they change [the rules on chemical use] that they say alright we'll pay another 10 per cent more for your sugar. Fine. Give me a more expensive chemical and I'll put it on. You pay for it, that's great. But [then] they all demand bloody sugar for nothing down at the shop.
>
> (Mossman Grower 13).

> They keep saying you have just got to do it … but who pays? I mean it is always us paying.
>
> (Tully Grower 26).

Tully Grower 3 referred to the example of consumers electing to pay extra on their power bills to fund 'greener' technologies and yet it is rare that consumers 'tick that box' because of the added cost. He used this example to stress the hypocrisy in asking growers to bear the cost for environmental regulations when the average consumer will not willingly choose to pay extra for environmental costs.

> I'd like to know – on the power bill, you get your green – I wonder how many people have ticked that box. It's a little bit dearer.
>
> (Tully Grower 3).

There were grower participants who felt that the efforts they had already made, at their own expense, were not valued. Their words implied that instead of being rewarded they now had to face the prospect of greater environmental regulations (perceived as an extra punishment). A Tully grower voiced his frustration about this issue.

> I think I'm doing the best practice I can. I'm looking after my river banks, I'm making sure they're vegetated. I'm putting these silt traps in. I'm putting in seepage pipes to stop run off and yes, I don't know what else they can get us to do. I really don't. And I didn't have to get pressured from them to do this because it was my own [choice] – you can see it through your own eyes, why let good sediment run out when a simple sediment trap can save it. You go and clean it every couple of years or whenever it need be and it's – I didn't have to be told by anybody.
>
> (Tully Grower 13).

A Mossman grower (MG13) said that no matter what they did the government and 'greenies' would still not be satisfied and that this was an example of overzealous demands being placed on industries in Australia that could force them to close down. He believed that one of the failures of environmental regulations placed on Australian producers was that when local prices rose to cover environmental standards costs then people turned to cheaper imported goods from other countries that had not met these environmental standards. He also thought that in cases like this the regulations were transferring the pollution problem to other (developing) nations.

> There is always a green group there somewhere that says whatever you are doing is bad. It doesn't matter whether you're putting on blooming egg yolks. There will be some reason why that will be doing damage… Basically all of this wonderful green movement in Australia, all they do is export their blooming problems. They buy their timber from Indonesia where they rape and pillage in Indonesia whereas here where we have a good industry that was all doing the right thing. Oh no, close that down. So you export the problem.
>
> (Mossman Grower 13).

Participants also discussed how 'good' the science was with regard to nutrient management and run-off legislation. Growers were sceptical about whether the science was 'right' and what methodology was used for determining enforced application rates. Mossman grower 12 was concerned about how reef protection scientists applied their data from limited monitoring sites when there were so many potential variables depending on rainfall, slope and soil type, etcetera.

> They'll just summarise "this should be about right for that area, amount of cane growing per head of people in this area here" and that's going to be our set

> goal. It's hard because they've got one [water quality monitoring device] at Saltwater [Creek], which is all pretty flat country, then we've got hilly country here, different soil types here, so it depends on how they monitor and depends where they [set the] level at. It's going to be an issue, definitely. It's going to be a big issue.
>
> (Mossman Grower 12).

> They [in the Burdekin[32]] can guarantee a crop though. Their crop basically is the same every year. They know they put that much in and they're going to get that much out. Whereas we put the same fertiliser on – I shouldn't say this on tape – but some years you get a good crop and some years you don't and I'm sure the bloody fertiliser is not there. That scheme where they say if you have a small crop you don't need to put on as much fertiliser the next year. I don't believe it. I think it either leaches or denitrifies or something because unless you've had an extremely dry year and you have a small crop I think maybe the fertiliser is still there but if you've had a wet year like we did… I think that theory there - you have a smaller crop so you put less the next year – [leads to] you have a smaller crop and you put less [on] and in the end you just spiral your way down until there's nothing.
>
> (Mossman Grower 13).

Concerns about the accuracy of the science behind nutrient run-off and recommended nitrogen fertiliser applications for sugarcane crops were not limited to growers and millers from the Sugar Industry Group but also extended to several of the Reef Protection Group scientists. These quotes expressed some empathy and frustrations about the issues of imperfect knowledge in this area.

> … but a sugarcane farm doesn't have to tell you how much fertiliser is going in and it certainly doesn't tell you how much it's losing. But if that becomes a requirement to maintain your farming licence, how do you do it? It's quite an extensive and unknown science at this stage … of water movement through the soil, run-off, all those sorts of things.
>
> (GS 19, Reef research scientist).

> A lot of that work is based on modelling that has some deficiencies in validation. There is some contribution. I don't believe that we have an adequate handle on the extent of that movement in this particular environment. Certainly, the base data that was used to calibrate the models has come from other areas, and that's based on X kilometres of drain per square kilometre of cane land, and the contribution from those X kilometres is assessed at Y tonnes of sediment, so it's been those figures which have calibrated the model and then that model has been imposed on the environment here, with some refinement. I would like to think that the models output is an overstatement of the actual output from the area.

[32] The Burdekin area, south of the Wet Tropics region, is somewhat drier and the growers there irrigate their crops.

(IE 2, Mill extension officer).

> I think they contribute some of the nutrient load and my argument would be that's mostly a regionalised impact or a local to regionalised impact. I don't think they contribute that much sediment load these days. I think in relation to both sediment and nutrient a lot of it is coming from outside of the sugar growing areas, particularly sediment. I think they have proportionately less contribution to – well beyond the coastal zone when you're talking about discharge into GBR environments. If you consider the whole of the GBR then the nutrient load issue is much more one about regional rainfall with the Wet Tropics being the exception that its consistent rainfall means there's leaching of nutrient throughout the rainfall period … that its consistent rainfall rather than this big event based stuff that you get in the dry tropics. You can be talking magnitude [of] difference.

(GS 31, Reef and freshwater research scientist).

A similar view was expressed by a senior representative from the regional Natural Resource Management Board (NRMB or *Terrain*) with regard to the effectiveness of regulations based on the current level of understanding of science about nutrient run-off. This participant, who provided advice into policy development, also proposed that nutrient management regulation could cause a regression in the progress of the relationship between industry and government with regard to environmental management issues.

> Within the next couple of years there will be pressure for regulation at the property end of the spectrum, and that's pretty problematic because there is not enough good science about how that's going to play out. Which is why we're suggesting in the next four or five years, you've got to focus on trying to achieve voluntary targets and putting the investment behind the achievements of those voluntary targets. It creates that window of opportunity for the industry to get its shit together and we expect there will be regulatory measures towards the end of that period. What I'm hearing from government - what we've been able to do is put off that risk at the moment - if regulation came down now, I think they would be very dysfunctional. It would upset the whole relationship between the industry and government. And it wouldn't have worked.

(GP 32, NRMB representative).

Two of the Industry Group participants (IM3 and IM11) said they were not concerned about the introduction of regulations about fertiliser use as they didn't think that a level would be set so low as to seriously threaten crop production. One of the mill participants voiced his concerns about who would bear the cost of implementing new regulations, along with the additional bureaucracy to deal with and problems in policing them. Regulations can cause adversarial industrial relations with the government and environmental NGOs, particularly when industry believes the regulation is not appropriate.

> I work in an agro-industrial environment where we're under regulation all the time. I don't have a problem with something like a nutrient budget that says, okay you've got 100 hectares of sugar cane, you're entitled to use 100 times 160 kilograms of nitrogen per hectare per year, and all those sorts of things, I think that's a nice simple way to reassure the general public that these guys are doing the right thing. I think that regulation is not a big drama. Implementation of it might be hard or more the policing of it, because what would concern me is that they just say, here's all this stuff, you go out and implement it. That's the thing we were talking about before, about industry doing public good work, and if public good work needs to be done, then the costs of it needs to be borne by the entire public. We're part of the public too.
>
> (IM 3, Mill representative).

A policy maker participant thought that the regulation of fertiliser use by cane growers might be conducted directly through the fertiliser industry. He also was of the impression that this way of regulating fertiliser use would not affect growers as much.

> I suspect there might be some regulation on the delivery of fertilisers. I don't think it will affect the farmer, unless he is required to report on what fertiliser he buys and what he does with it, but that would be the sort of level of effect. I think certainly there is every likelihood that the fertiliser industry will be further regulated in terms of reporting of what they're selling out there, where it's going, what quantities and what types, but I don't think there's any likelihood that government is going to put forward a regulation where a farmer has to undergo 'six easy steps'[33] [the recommended nutrient management practice] in his fertiliser management.
>
> (GP 18, Government policy maker).

Most of the growers and industry participants believed that the development of more environmental regulations was not the solution to fixing the problem. A senior GBRMPA policy maker participant involved in the development of the Reef Plan said that making regulations was not a simple or easy alternative.

> There's no silver bullet. If it was easy to regulate, you would have done it.
>
> (GP 18).

This Industry Group participant, who worked for a sugar industry association, highlighted the difficulties involved with enforcement.

[33] Six Easy Steps to improved nutrient management (Schroeder, *et al*., 2005).

> For me, they [NGOs] don't understand the cost benefit of it all. We've got 22 million [people] right across Australia. The EPA is stretched like nothing else on earth. I just think it's unrealistic. It's very resource intensive. Imagine the court cases. It has hairs on it. As I say, the easiest thing in the world, when you're sitting there, is the World Wildlife Fund saying, oh let's regulate. They've got no idea about the complexity of it all.
>
> (IA 9, Industry Association).

Regulations can be problematic and create a range of new unforeseen problems that then have to be managed, all of which create extra governmental costs. Industry Group participants talked about a range of difficulties associated with enforcement of environmental regulations. A Tully grower and a cane growers' association participant pointed to some problems associated with the policing and enforcement of regulations.

> …….but there's not much policing of it. It's only if a neighbour complains. If you can keep in good with your neighbours and do the right thing [you're OK].
>
> (Tully Grower 16).

> You need an enormous number of regulation police to make sure it happens.
>
> (IA 21).

A tourism operator from the Reef Protection Group pointed to perceived flaws in a potential regulatory system. He thought that the pollution problems were stemming from smaller 'marginal' cane farms and spoke about the difficulty in tracking the origins of diffuse sources of water pollution.

> When it comes to compliance, are they going to be able to check the individual cane paddock, whether they'll again just target major water systems … which means that they miss a lot. The smaller, more marginal cane farm, they're the ones where the issues are. They don't directly flow into major water systems, they flow into creeks which then flow into the major water systems, so it's hard to track the offenders back to the point source.
>
> (T 22, Tourism operator).

Regulations tend to be designed as a blanket rule for everyone in an endeavour to reduce the costs of administering them and to appear egalitarian in the process. However, regulations have a history of punishing everyone, even when they had been designed to do the right thing. For example, the cost to the U.S. alone from the global banning of CFCs was estimated to be in the thousands of millions of dollars, even though evidence later demonstrated no clear links

between CFCs and depletion of the ozone layer (Haas, 1992a). Regulations can cause a variety of secondary and tertiary costs and other burdens while failing to effect desired changes in the behaviour of the 'recalcitrant' individuals (Bager and Proost, 1997; Haas, 1992b; Jasanoff, 1987; Palacios, 1998; Wynne, 2005; Zalom, 1993). Further analysis and discussion of the issues regarding regulations is continued in the next chapter.

5.3 Views on Grower Adoption

Through the course of the interviews it became apparent there were gaps in the Reef Protection scientists' knowledge and understanding of the history and details of the sugar industry that were affecting grower adoption. This section provides insights into some of the issues in the relationship between Reef Protection participants and the Industry participants when trying to facilitate industry to become more 'ecologically modernised'. When using EMT-style policy, government and scientists usually work closely with industry to understand their economic needs and capacity when recommending improved methods of production in order for the innovations to be well received and deliver intended win/win outcomes. This section teases out these details and explores why some recommended practices were taken up willingly and quickly and some were not. Table 5.2 summarises some of the major differences examined below.

Table 5.2

Summary of Participants' Views of Grower Adoption of Recommended Practices.

Grower Adoption	
Sugar Industry Views	**Reef Protection Views**
We have adopted many of the recommended practices.	They resist good scientific advice, which can help them be better farmers.
We've tried almost every recommended practice – other than previously tried ones that have failed, or ones that to us will obviously fail.	They avoid change and can't see how our advice can help them. They are ignorant and backward, old-fashioned, uneducated and stubborn.
We prefer innovations that improve our profit margin (or save time).	If they are going to be resistant, they need to be forced to change their practices.
We don't like recommendations that will cost us more in time and money, without any pay-off – especially those that cause us to lose more income.	There are some 'good' growers who 'understand' and adopt the recommendations.

5.3.1 Sugar Industry perspectives – focusing on Green Cane Trash Blanketing

The biggest success story in the sugar industry for the adoption of a recommended environmental practice was Green Cane Trash Blanketing (GCTB). GCTB is the practice of cutting the cane green without burning the stalks and leaving behind the harvest trash as a blanket to retain moisture, prevent weed growth, fertilise the soil and reduce tillage. Grower participants' expressed their pride and sense of achievement about their adoption of GCTB. Most of them openly talked about the economic benefits firstly, which translated to improved productivity, then followed with a list of environmental benefits. Improvements in productivity were the most frequently discussed reasons for changing their practices. Improvements in productivity translated to improvements in their profit margins. They were willing to spend the time and money to adopt a new practice when it was evident that the returns would result in increased productivity or profitability not long after implementation. Quotes from two Tully growers' reflected these views succinctly.

> It comes back to [that] it's got to be profitable and the practices aren't really the barriers, it's the return price in the end.
>
> (Tully Grower 1).

> If it's going to save you a dollar, you do it. If there's a financial gain, you're going to change, aren't you? It's like any business.
>
> (Tully Grower 3).

The widespread uptake of the GCTB practice happened in a very short period of time, over approximately ten years. Seventy-five percent of all growers in Australia were undertaking GCTB by 2005, which then increased to eighty-five percent by 2010[34]. These figures included ninety-seven percent of growers in the Wet Tropics who had applied GCTB (Parker and Rudd, 2006; Wrigley, 2005; Wrigley and Moore, 2006). This level and rate of adoption for a new practice would be considered quite radical within *any* industry.

When grower participants were asked about GCTB, their body language changed during the interview. They sat up in their chairs and leaned forward, relaxed their brows, opened their eyes wider and spoke with a more enthusiastic tone. This was a topic they were happy to discuss compared to the other topics discussed in the interviews. Growers and other industry participants commented on the economic and environmental benefits from adoption of GCTB

[34] Canegrowers (Organisation), 2010.

(after the initial outlay of investment in modified machinery) including the benefits to the whole industry such as an improved public profile. They were very proud of the overwhelming adoption rate of this practice in the Wet Tropics region (which has the highest adoption rate in the country). Each grower participant had applied this practice. A Mossman grower and an Industry Group participant from one of the mills talked about the impact that the switch to GCTB had on growers.

> The biggest change has been going from burnt to green [GCTB]. That is one hell of a change and it's working really good. Well because you're not working your ground and you're not getting any runoff, so your topsoil is remaining there. I've cut some of my best years by not working it. I think too, the ground not worked, when we get that big, heavy rain, instead of it all soaking in there and making a pudding, a lot of it's running off. But when I say running off, the water is, but it's coming through the trace [being filtered]. So we're not getting any earth moving. That's a big change in my lifetime of farming. And I was one of the first ones to change here. Now it's right through the industry.
>
> (Mossman Grower 5).

> We have 97 per cent plus of supply to our factories that is green harvested these days. Green harvested and trash planted. I think that we have got our nutrient levels particularly good. I can't think of another industry. I know for a fact that there isn't any other industries that are even close to ours that have such well-tuned nutrient recommendations, such a history of fertiliser use trials, such specific soil analyses for sugar cane.
>
> (IM 3, Mill manager).

Once growers changed over to GCTB they then saw the evidence of a range of benefits beyond increased productivity. GCTB reduced the potential for run-off of soil and nutrients, the trash provided nutrients as it decomposed and the 'blanket' kept moisture in and reduced weed growth and the need for using herbicides. The adoption of GCTB reduced growers' workload and also eliminated the need to burn the crop prior to harvesting, thereby preventing air pollution. Because of GCTB growers worked their soil less, minimising their tillage, which resulted in reduced soil compaction and less fuel usage. Two Mossman growers demonstrated growers' awareness of the many side benefits that resulted from GCTB and their pride in both their economic and environmental achievements.

> Because green trash blanketing opened up a window for a lot of people you could manage bigger farms, you could see the benefits in the nitrogen input from the trash blanket; but mainly that you didn't have to spray as much as you had to; less chemicals, because of the weed control. That's why green trash took off, and there's been nothing like that happen in the industry for a long time. Nothing else has sort of hit us between the eyes like trash blanket.
>
> (Mossman Grower 8).

> I believe the soils are a lot healthier since we've been trash blanketing. There's a lot more earth worms in the ground than there ever were.
>
> (Mossman Grower 14).

Each of the growers and most of the Industry Group participants emphasised how the run-off of sediment and nutrients had been curtailed since green cane trash blanketing began. However, growers also said they were not acknowledged for their efforts and achievements by the 'greenies' or by the Reef Protection Group scientists and policy makers. A Mossman grower and a Pilot grower shared their views:

> I think we've changed a lot. In the last ten to fifteen years there's been a lot of changes, especially going to green cane because before that every paddock was cultivated every year, and now we don't touch a paddock for four or five years, so there's no cultivation going on. Plus the trash blanket stays on the ground, which helps with the weed control, so we use far less chemicals for weed control.
>
> (Mossman Grower 12).

> But I don't think we're as bad as we're made out to be by some people, especially since the green cane trash blanket came in, because there's a hell of a lot less soil disturbance. Well, there's probably only 20 per cent of the farm disturbed whereas before it was 100 per cent.
>
> (Pilot Grower 2).

GCTB was considered by all in the Industry Group and some of the Reef Protection Group participants to be a greatest success story for enabling the industry to be more sustainable, both economically and environmentally. It perplexed Industry Group participants that their adoption of this practice was not received with enthusiasm by many of the Green NGO participants, Reef Protection Group scientists and government policy makers.

Some Reef Protection Group participants, particularly those who worked more closely with growers (such as the extension officers), shared enthusiasm in the high rates of adoption of GCTB and its positive environmental outcomes. There were more Reef Protection Group participants, particularly scientists, some policy makers and the Green NGO participants, who were not as impressed about the adoption of this practice. These were usually the participants who had the least interactions with growers and the sugar industry and knew less of the details of GCTB. Few of these participants were aware of or able to the list the positive environmental outcomes from applying GCTB and the extent to which it reduced run-off of sediment and nutrients to receiving waters.

5.3.2 Industry perspectives on Grower Adoption

There were other recommended practices discussed by grower participants that had not been as beneficial or welcomed by the growers. All of the grower participants had tried at least one recommended practice and most of them had tried many. Growers were not averse to making changes, provided the benefits were clear and demonstrable and helped to improve productivity. In fact, many of the grower participants had trialed some recommended practices, even when they had doubts about the promised benefits. Without exception, all of the grower participants said that they made their decisions about a new recommended practice based primarily on evidence they saw for themselves on working farms in their locality and on weighing up the pros and cons of any efforts involved. The following quotes are from participants who provided their reasons for taking up or not taking up a recommended cultivation practice. They refer to the cost of changing to a new practice and whether the incentive to change was strong enough to offset the risks and costs. In the case of some recommended practices, such as direct drilling of nitrogen fertiliser into the plant stool, many growers tended to be unconvinced or were wary of whether the results would pay off. Grower participants expressed the need for more certainty, otherwise they preferred to rely on the risk management methods of the past, such as putting on another bag of urea to compensate for anticipated or perceived losses.

> I've seen the studies and I've been to conferences on it, at the end of the day the cost in getting involved and doing control trafficking[35] … you're not being paid enough to go in to it. Look, the incentive is not there. What we adopt is basically watch everyone else do it and if it's worked, … let them do the hard yards and then we'll just adopt it, … because the incentive isn't there. Incentive is not there, because at the end of the day if it fails it's cost you. And the margins are too low.
>
> (Tully Grower 40).

> All these 'you beaut'[36] ideas have got to be proven to be worth something. That machine [for stool splitting with direct drilling of nitrogen fertiliser] probably cost $20,000 or $25,000 so that's a lot of cane you've got to grow to justify buying it and if you can't see any difference why would you? Plus it's slower to apply and all the rest of it. You can still put another half a bag of urea on. [Its] cheaper than buying that machine.
>
> (Mossman Grower 2).

Three Mossman growers talked about the need to see results before adopting the practice of dual row planting techniques (a practice designed to increase efficiency and productivity while

[35] Reduced traffic refers to methods that contribute to the reduced number of passes that machinery makes over the soil and this helps to reduce compaction of the soil from heavy machinery.
[36] 'You-beaut' is an Australian colloquial term meaning that the thing it is referring to is wonderful or amazing; and is sometimes said with a sarcastic tone to mean the opposite.

reducing the amount of traffic and soil compaction). One of them elaborated further by stating the need for financial rewards when investing time, hard work and money into innovative practices that seemed to be more about a 'green benefit' than a grower's benefit.

> But double row [dual row planting] has been tried here and it's never proven to give you results.
>
> (Mossman Grower 5).

> It's [dual rows] not taken off because we're not seeing results. And when you see results, you do take it [on].
>
> (Mossman Grower 8).

> I've been prepared to try things. Innovation for innovation's sake … apart from costing you money that you have to start all over again because it didn't work. You've just gone ahead and grown less cane. I will use less chemicals, I will do all sorts of things if I believe that I'll be saving money by not doing it, and a secondary benefit is if there's a green benefit. But I'm here to try to make money and if I'm gonna lose money by doing it, I certainly – I wouldn't even entertain it. I change practices to make some money out of it, that would cut costs over the years.
>
> (Mossman Grower 6).

A Mossman grower talked about the dedication, faith and determination required to trial some practices along with the frustration from failures and added burden of costs in time and money. He shared his experience of the time he tried to grow different types of legume crops as a recommended natural means of replenishing nitrogen back into the soil, rather than leaving the land in a bare fallow or having no fallow at all. He also shared his views about the practices that work and the ones that do not and his reasoning why.

> Yes, we've had a number of experiments here that were tried and failed. I did a mung bean trial up in the Daintree farm a few years ago. Basically you rely on rain and if it didn't rain when it was supposed to and it rained when it wasn't supposed to and things like [relying on] a lot of insecticides. Actually we bagged these things [mung beans] up and sent them down to Kingaroy and when they got there they wanted to send us a bill for blooming transport because they went mouldy in the bag … so we didn't rush out to do that again. But you know I've been messing with soya bean here. But then I didn't like the idea of working all that ground up before the wet so we tried spray out and drilling them straight on top of the stool. They've had very little success with them on top of the stool. I actually put some cowpea in because the soya bean [advice] said that you had to grow them on a hill and do all that and I said, well why can't we do that with cowpea? They are a lot more robust and they did all

> right. Better than the soya bean anyway. Bugger the soya bean. The soya bean put in more blooming nitrogen supposedly but not if they don't grow.
>
> (Mossman Grower 16).

Two Tully grower participants expressed their frustration at the inferred promises made about growing a soya bean crop and the failures they experienced either first hand or from other growers' experiences. Soya bean crops repeatedly failed in the high rainfall areas of the Wet Tropics.

> Soya beans is a cash crop, down the Burdekin [region], down south. Six hundred bucks a hectare or something cash crop. My old man grew bloody soya beans. The night we went to pick the soya beans, we got a mongrel drizzle. They split and got full of bloody mildew. So don't give me that bullshit about bloody 'you can save yourselves if you want to do this' and all that. Excuse me, but we can't do that up here.
>
> (Tully Grower 9).

> Look, it's pointless on my land [growing soya beans or chick peas] because we're in flood prone areas. So it's pointless. You can't. All that does is suddenly it creates a bare fallow for me and I don't want a bare fallow because I know as soon as the rains hit – say I plant them in December and the rains hit in January, the beans are dead and suddenly I'm looking at raw dirt. I'd rather see my old routine just sitting there, sprayed out, and it's holding the soil.
>
> (Tully Grower 13).

A common experience of trialling 'fallow crops' in the Wet Tropics region has been that the recommended legume has not grown effectively in this climate. A lot of the growers used their own initiative to trial alternative legumes and experienced some success. Like so many other growers who share the farming business with a family member, a Mossman grower (MG16) also had to contend with his brother's more sceptical views on all of these trials. A failed experiment by one of the members of a shared business operation could result in a greater reluctance to undertake further trials.

> I've had a few arguments with my brother over that. He's not real keen on fallow because he argues that you are just losing a crop. Then I go out there and spend all this money on cowpea and soy bean and he's like, what the hell are you doing that for?
>
> (Mossman Grower 16).

Constantly living under the close scrutiny of their peers, grower participants were reticent to undertake actions that might cause them to lose face. This affected their uptake of some recommended practices. If the practice being recommended was perceived as a high risk and a substantial effort, with a low or marginal rate of success and a small productivity gain, then the majority of growers shied away from trialing it. These growers often viewed the frontrunners who trialed an unproven new practice to be foolish and it was not in a grower's interest to be considered to be foolish or a failure in their community, as expressed in the following statements.

> What other farmers think is a lot. People are very proud people, farmers are very proud. They worry about failure.
>
> (Pilot Grower 1).

> I can't afford to waste that money, because I don't want to make a wrong step.
>
> (Tully Grower 9).

> It's the people who push the boundaries take big risks and stand to be humiliated over their passionate desire to change.
>
> (Tully Grower 18).

Grower participants talked of the hidden costs of some recommended practices and this caused them to be much more careful about adopting further practices. Growers were disgruntled with not being told the real or full costs of introducing a new practice or of modifying an older practice. There were many cases of hidden costs that were reported by grower participants. A Mossman grower discussed a few examples of hidden costs in adopting the recommended practice of widening row spaces from five feet and two inches (or 1.55 metres) to six feet (or 1.8 metres).

> That's how they do it [controlled traffic] in the Ord [northern Western Australia] and it grows good because they can get their massive crops but here we don't get massive crops. We get it by rows of plants. It might be only two or three or six inches per row [which] doesn't sound very much but it does add up after a while. Loss of rows and as soon as you lose a row [you lose volume] and unless you've made that up in the bigger crops and bigger space … and all the gurus tell you that they [the cane plants] will be bigger but I haven't seen it in practice here yet.
>
> (Mossman Grower 2).

> The other thing is it takes so bloody long to do it. Our high-rise tractor is set at five foot rows - based on five foot two [inch] row spacings. If you go to six foot I've got to make major modification to that sort of thing and because it takes so long to convert your farm you're stuck with different row widths for at least ten years.[37]
>
> (Mossman Grower 2).

He also commented on the hidden costs of some other recommended practices. He had undertaken the construction of a wetland and was surprised at all the extra costs and efforts required to construct it according to governmental guidelines. He was also sceptical of the savings that were proposed from using the fertiliser injection method (with a stool splitter) versus the costs of the machinery modifications required for this practice.

> It always seems that you never ever apply for enough labour. I put down [on paper] 40 hours on that thing [recommended revegetation and constructed wetland project] but I don't know how many bloody hours I spent on that sort of thing. I put [my labour] down at $20 an hour, you can't get any mechanic or anything less than $60 now.
>
> (Mossman Grower 2).

> I know one of the farmers around here got a grant to buy a stool splitter where you put the fertiliser in the middle of the stool. Whether he saved fertiliser from going out to the reef or not it can't be proven but his crop was certainly not any better than anybody else's last year… and that machine … cost $20,000 or $25,000.
>
> (Mossman Grower 2).

Quite a few of the Mossman growers took up the recommendation to grow cocoa crops for a potential cocoa processing plant to be built in Mossman[38]. This innovation was eagerly promoted and some growers were keen to try growing a cocoa crop as a cash crop after being alerted to the commercial value of specialty chocolate (often quoted at cocoa growing information seminars as more expensive than gold, gram for gram). No one had grown cocoa at a latitude this far south before but researchers were optimistic about its horticultural success. Grower participants claim they were not briefed about the level of physical commitment involved in growing a cocoa crop. The crop needed to be picked by hand. The growers who

[37] The change over period to different row widths can take many years as it can only be achieved with a replant of the cane, which is done after several ratoons and on a rotational basis for each paddock. In the meantime, differing row widths creates the need for two sets of machinery and extra work for the farmers and the harvesters.

[38] Growers in Mossman have been encouraged to trial the growing of cocoa for lucrative specialty chocolate markets. The Mossman Mill collaborated with representatives of the Australian cocoa industry to facilitate opportunities that not only could provide added income for sugarcane growers but might also stimulate a future niche market for "green sugar" producers to supply chocolate manufacturers as well.

grew cocoa were mostly in their fifties and older and were unable to afford extra labour costs. One of the Mossman growers shared his concerns about the commitment and effort required to grow a cocoa crop when there still was not a viable market.

> I just want to stick to sugarcane. I did cocoa. I thought that'd be easier, but I've spent a lot of time up there. It's a lot of hands on. Yeah, it's very hard work.
>
> (Mossman Grower 7).

Overall, growers provided many reasons why they adopted a new recommended practice or not. They intimated that a recommended practice has to be economically and physically viable for an industry to take them on and the change in practice has to provide a market advantage. As discussed in Chapter Three this is also one of the core principles of EMT.

5.3.3 Perspectives on recommended fertiliser practice

Sugar Industry and Reef Protection perspectives on Grower Adoption focused on growers' fertiliser practices. Sediment run-off from sugarcane farms should no longer be of concern for policy makers since recent evidence suggests little of the sediment actually originates from cane farms (Bartley, *et al.*, 2004). It nevertheless remained part of the participants' narratives with Reef Protection participants still referring to sediment run-off from cane farms while Industry participants argued that this was shown to be no longer the case. The most contentious issue that divided the two main groups of participants was that of the fertiliser (nutrient) run-off from sugarcane cultivation being or not being the main cause and source of nutrient pollution to the GBR. This section analyses growers' perspectives on this topic.

Growers reported that successful crops were those that had the highest volume and thereby earned the most income. Because growers are paid according to the volume of sugarcane they send to the mill, most growers believed that to cut back on fertiliser would compromise their crop yields and their income. Without exception, all the grower participants stressed the need for fertilisers to grow a successful crop. Two Mossman growers (MG4 and MG5) expressed their views on this point.

> The ground needs tucker, and if you're cutting back on it, you know for a fact that you're not going to have your crop. And if you're not going to have your crop…[you won't get the income].
>
> (Mossman Grower 4).

> Very early days Dad told me that when they first came on the farm it grew about 300 tonnes, I think. That was '33 – yeah, would've been '33 – no '32. '32, they grew 300 tonnes, '33 they put some fertiliser on and grew 800 tonnes. It was great.
>
> (Mossman Grower 5).

Some of the Reef Protection Group participants (GE 5 and GS/E 8) believed that to cut back on fertiliser use would not be commensurate with the interests of the milling sector because it would cause a reduction in the volume of cane grown. The cost savings and increased CCS levels rarely, if ever, offset the loss in income from reduced tonnage. At the same time, any reduction in mill profits automatically threatened the mill's sustainability.

> The interesting thing is that in delivering that profitability increase and the improved sugar system for the actual individual enterprise it may not be 100% commensurate with the interests of the milling sector.
>
> (GE 5, Government Extension).

> The failure I believe of the corporate millers in particular to take a bit of a holistic view of the industry and start moving in the direction of doing things that will benefit the industry overall and not just benefit the tonnes of cane that go through their mills. I think that's really holding the industry back.
>
> (GS/E 8, Scientist/Government Extension).

One of the Reef Protection Group participants who was a government extension officer (GE 13) explained how the system of payment by volume is embedded in all of the mill, grower and industry association levies and payments. The entire payment system throughout all sections of the industry was based on the volume of sugarcane production and throughput.

> The mill requires tonnes, throughput. The growers basically have this paranoia about tonnes. The levy is based on tonnes for cane growers, for all the organisations you pay on tonnes. So, if you drop your tonnes but increase your quality of sugar your profit might not actually go down but the levy – people who use tonnes as a levy based, like Canegrowers Organisation and ACFA; the amount you pay the mill for your contribution, the grower's contribution towards the maintenance of the track and services, like testing services and all that. All that is done on cents per tonne. So, all that sort of stuff would need to change as well. So the whole system, the whole industry is set up on tonnes, which is a productivity measure not a profitability measure.
>
> (ISE 13, Government Extension officer).

Sugar Industry Group participants (such as TG6, PG2 and IM11) spoke of fertilisers as providing an 'insurance policy' against unpredictable climatic conditions and for producing a bumper crop. They said that fewer non-legislated variables remained for a grower to control according to his own knowledge and experience, but they were still able to make their own decisions about the amount of fertiliser they thought their crop required. Having the power to make their *own* judgements and decisions about their everyday work practices was important to them.

> I know the old generation would say it's an insurance policy. I put more on – insurance policy.
>
> (Tully Grower 6).

> A lot of blokes have got this – a lot of people have got this idea, just put a bag or two [extra]. When I say a bag or two, it's 50 kilos per acre which is only $25 or $30 a bag [at the old price] and that's the best insurance you can have.
>
> (Pilot Grower 2).

> A lot of those farmers view it as insurance. They don't want to have perfect growing conditions and have their crop limited by lack of fertiliser. If they're going to grow 150 tonnes to the hectare crop, they want to have the fertiliser to grow it.
>
> (IM 11, Mill staff member).

During the period of time that the interviews were being conducted (2007-2008) the cost of fertilisers and fuel had doubled and then later trebled causing growers to make significant cutbacks in the amount of fertiliser they used. Grower participants were not happy about the increase in costs or the way they were forced to deal with it. When Mossman Grower 11 was asked: "If you had the money to do anything you liked to improve your farm, what would you spend it on?" He replied: "I'd spend it on more fertiliser". Grower participants also stressed that without adequate volumes of sugarcane, the mill suffers economically as well.

5.4 Perspectives on Mills

The perspectives on Mills can be found threaded throughout the other themes. This section includes some specific quotes and analysis of the theme on Mills through the lens of EMT. Comments made by growers and mill staff showed the strong relationship that exists between mills and growers and how this affects grower adoption. A summary of these issues is depicted in Table 5.3.

Table 5.3

Summary of Participants' Views on Mills.

Mills	
Sugar Industry Views	**Reef Protection Views**
Some growers say that they do what the mills tell them to. Some growers say that mills do not tell them *how* to grow their cane.	If mills tell them what to do, then we need to exert pressure on mills to get growers to change their practices.
We can't exist without them and they can't exist without us.	The industry is complex and has internal problems, so regulations would solve all that.
There are times growers argue with mills, but they each support each other when times are tough because they are co-dependent.	The structure or culture of the industry is not important. Can't see how it affects management of the issue if regulations are applied.

Unlike many other industries, the sugarcane industry is made up of separate independent business units (such as individual growers, harvesters, millers and marketing board) that depend on each other in order to remain in business. For the industry to succeed, each of its business units need to be profitable in order for the whole of the industry to be economically sustainable. Growers cannot function without harvesting contractors, a transport system and a nearby mill. The mills also need to directly market their sugar or rely on CSR to market it for them. When environmental policy is designed for one part of the industry it will thereby affect all parts of the industry. Policy makers need to be cognisant of the downstream effects on the whole of the Australian sugar industry for their policy measures to deliver the intended outcomes. Growers are well aware that if the mill is threatened then growers are consequently threatened. The following quotes express these participants' views in their own words.

> The cost of fertiliser this year has doubled to what it was last year and that's going to be a big issue this year, for the future of what crop we grow. Without a crop, the mill has got no income.
>
> (Tully Grower 5).

> Sure, we put our fertilisers in the best places now and we can cut back a touch. But if we keep cutting back the crops fall away and then suddenly income's gone. So sustainability, I haven't got the answer any more.
>
> (Tully Grower 13).

> It all comes back to … if you don't put the fertiliser [on] you won't grow the crop. I mean if you keep cutting back on fertiliser, as we've done over the last few years for obvious reasons, your crop goes down. Now, you can cut back so much and you'll grow a lower crop, but there's a certain stage where if you put no fertiliser [on] you'll grow no crop at all and you're gonna be out of business anyway. There's got to be a minimum.
>
> (Mossman Grower 5).

Growers and other sugar industry participants strongly stressed their need to produce adequate volumes of sugarcane in order to make a profit. The entire industry payment system was constructed through the measure of the volume of sugarcane that was produced, harvested, transported, weighed and processed into sugar crystals. Grower participants perceived that the recommendation to reduce their fertiliser use was a simultaneous request to produce less volume of sugarcane, thereby resulted in less profit for them, the mills and everyone else involved in the sugar industry. The recommendation to reduce fertiliser use was perceived as a recommendation that endangered the sustainability of the regional industry. Sugar Industry participants were not convinced of the Reef Protection Science that was used to validate the pressure applied on growers to adopt this practice and there had been no offer of compensation to offset any resultant loss of income. Growers in particular were upset and frustrated that they were being coerced into adopting this practice. They perceived that the 'greenies' and the government did not care about them or their industry and that government was more interested in 'going for green votes' over the sugar industry's concerns, growers' livelihoods and the income generated through sugar exports.

5.5 Conclusion

A crucial factor affecting the adoption of recommended fertiliser practices is the perceived negative impact to income and profits to be borne by the Sugar Industry Group. This factor has been generally overlooked or dismissed as untrue or invalid by the Reef Protection Group. EMT provides a framework for critically analysing the effectiveness of policy design and its application. In particular, Mol's (1999) four core features of EMT highlight the elements of policy that enhance or impede the desired environmental and economic outcomes. Unless the government facilitates policy design that provides a win-win outcome for both industry *and* environment then the outcome will neither be sustainable nor 'ecologically modern'.

One of the issues raised in the analysis thus far is the reliability of the science used to support and validate the Reef Protection policy. In this study, science is one of the contested knowledges that impinges on the efficacy of the policy designed to achieve a more sustainable

sugar industry. The Sugar Industry Group spoke of other non-consensus scientific studies that produced evidence that challenged the dominant view, thereby contesting the science. Reef Protection Group participants did not consider their science to be contestable and no credence was given to the possibility they might be wrong. Many of the Reef Protection Group participants had no knowledge of the counter-consensus science and where participants did know of its existence they were dismissive of it.

The analysis thus far has also provided a clearer understanding of the relationship between growers and mills. There were times that growers opposed mills and times that they rallied to support them. Growers did not want to jeopardise the viability of their regional mill by sending them reduced volumes of sugarcane, which translates into less income for the mill. This only exacerbates the threat of closure for a mill that is already financially stressed (as in the example of Mossman). Reduced volumes of sugarcane are perceived as a 'lose-lose' scenario for both the growers and the mill. In EMT terms this would result in an innovation that not only provides no market advantage for industry, but instead threatens the economic viability of the industry and thereby is anti-EMT.

Both Industry and Reef Protection Groups reflected and repeated the knowledge from the source that they trusted. As a result, each group had difficulty hearing alternative views. A notable difference was that Industry participants knew of and understood the views of the Reef Protection Group, while most of the Reef Protection participants did not know of or understand the Industry participants' views. Many of the Reef Protection participants were not well informed about the agronomics of the industry or its operations, economic drivers and market dynamics. The grower participants felt they were not being *heard* or consulted on their knowledge and understandings of their industry.

Chapter 6 Sustainability: An EMT Analysis

6.1 Introduction

This chapter deploys an EMT approach to interpret the theme of Sustainability. Sustainability emerged as the overall dominant theme that underpinned participants' knowledge and understanding of sugarcane growers' cultivation practices and the role they play in terms of soil and nutrient run-off flowing to the Great Barrier Reef. A review of government's perspectives on sustainability is followed by participants' views, which are presented and analysed in this chapter and then interpreted from the perspective of Mol's four core features of EMT. The analysis raises more questions than it answers, however, and at the end of the chapter the need for another set of theoretical concepts is discussed.

6.2 National perspectives on Sustainability

The term Ecologically Sustainable Development (ESD) originated in 1987 from a report by the United Nations World Commission on Environment and Development titled *Our Common Future* (commonly referred to as the Brundtland Report) and it called for

> *...a form of sustainable development* which meets the needs of the present without compromising the ability of future generations to meet their own needs…
>
> (World Commission on Environment and Development, 1987:8).

Soon afterwards, in 1990, the Commonwealth of Australia then suggested the following definition of ESD for Australia:

> …using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased.
>
> (Commonwealth of Australia, 1992:6).

At the same time the government recognised the need to utilise those resources to develop industry and generate employment (Commonwealth of Australia, 1992). Before the Brundtland Report, discussion on the relationship between the environment and economy had centred around the notion that growth and environmental quality were always competing and mutually exclusive goals. This view was stated in such publications as the Club of Rome's *Limits to*

Growth (Meadows *et al.*, 1972). The 1990 definition of sustainable development argued that the relationship is much more complex. Pearce *et al.* (1989) argued that economic management is capable of impacting positively on the environment and that improved environmental quality can enhance the performance of the economy. The concept of ESD recognises that concern for the environment can bring beneficial outcomes for the economy. Unlike the Club of Rome authors, the Brundtland Report focuses on development, rather than simply on growth.

In 1992 the Council of Australian Governments endorsed the National Strategy for Ecologically Sustainable Development (NSESD) comprising of seven guiding principles. The strategy recommended decision-making processes should integrate both long and short term economic, environmental, social and equity considerations and where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. It recognised the global dimension of environmental impacts of actions and policies along with the need to develop a strong, growing and diversified economy that enhances the capacity for environmental protection. The strategy also recommended maintenance and enhancement of international competitiveness, adoption of cost effective and flexible policy instruments and broad community involvement in decisions and actions that affect them (Commonwealth of Australia, 1992).

In both the Brundtland Report and Australia's NSESD, the economic, environmental and social facets of sustainability were attributed with equal importance. According to the Australian Working Group on Sustainable Agriculture (1991) ESD cannot be defined or considered in static terms: it is not simply about maintaining a given standard of living, a given state of environmental amenity, or even a given stock of natural resources. The concept, to be relevant, must encompass the dynamic processes of changing human wants and needs through time, as well as developments in human knowledge and technological capacities. The Working Group developed a set of five principles for sustainable agriculture against which policies at all levels of government could be judged:

1. farm productivity is sustained or enhanced over the long-term;

2. adverse impacts on the natural resource base of agriculture and associated ecosystems are ameliorated, minimized or avoided;

3. residues resulting from the use of chemicals in agriculture are minimized;

4. the net social benefit derived from agriculture is maximized; and

5. farming systems are sufficiently flexible to manage risks associated with the vagaries of climate and markets (Working Group on Sustainable Agriculture, 1991).

ESD in Australia has continued to be defined by successive governments in the same way as it was defined in 1992. No change or replacement has been made to the NSESD. In other words there is a nationally accepted definition of ESD that was designed to underpin all of Australia's policies made since 1992. Although there is international admiration for Australia's rapid development of an NSESD there have also been criticisms made of Australia's NSESD policy performance. For the purpose of this study, however, I will use the definitions of ESD and Sustainable Agriculture outlined in the NSESD as the yardstick from which to analyse and discuss participants' views on sustainability in this and the following chapters.

6.3 Differing views on sustainability

A dominant theme emerging from the research was a contested vision of 'sustainability'. Participants were asked about their views on the sustainability of the sugar industry generally, and the sugar industry in the Wet Tropics in particular. The responses varied across both groups, as did the understanding of what 'sustainability' meant to them. Participants in the Sugar Industry Group thought 'sustainability' was more concerned with being commercially or economically viable, and for the Reef Protection Group it was more about being ecologically viable. Although there were views located between these two opposing positions, including the view that industry needs to be *both* economically and environmentally viable, the dominant positions were distinctly oppositional. The analysis of participants' views reflected a pattern that occurred throughout the analysis: there were two opposing sets of opinions on a range of issues. The opposing sets of views on sustainability are summarised in Table 6.1.

Table 6.1

Summary of Participants' Views on Sustainability.

Sustainability	
Sugar Industry Views	**Reef Protection Views**
Sustainable means economically viable first.	Sustainable means environmentally viable first.
The experts put environment before farmers and farming.	Growers put profits before environment.

Sugarcane growers uniformly defined sustainability in terms of economics first and the environment second. The following statements made by growers are examples of their views.

> I think that a sustainable cane farm is one that one person can manage, full-time employed on it, and can support a family on that income and be able to renew equipment as needed. The farm also must have a minimum effect on the environment and be able to continue into the future. It also needs to be able to afford to expand operations.
>
> (Tully Grower 2).

> [Sustainability means] cut costs and increase productivity. And I think environmental now, too. I think eyes are always on us.
>
> (Tully Grower 3).

> Sustainable agriculture is being able to firstly be able to afford what you're doing.
>
> (Tully Grower 21).

> That there will be an industry here in the future and we'll be self sustaining.
>
> (Mossman Grower 16).

> Eventually it comes back down to what you're getting for it in dollars at the end of the day. You can have the best practices in the world and if you haven't got any dollars, well, it doesn't matter.
>
> (Mossman Grower 2).

> Being viable. Not putting more in than what you get out of it … but linked into the environment as well.
>
> (Mossman Grower 8).

> Having the farm there for my kids. Still making a profit off it, living off it.
>
> (Mossman Grower 12).

> Meaning that you can carry on farming … that you can carry on into the future and that you're not impacting negatively on the environment, and that you can keep your production levels up so that you can remain viable and competitive with the rest of the world. Just being able to keep farming into the future.
>
> (Mossman Grower 14).

Participants from the Reef Protection Group such as the extension officers, reef tourism operators, the NRMB and a scientist from SRDC shared views that the industry had to be both economically viable *and* environmentally viable. However, almost all of the Reef Protection Group scientists and government policy makers put the environment before the industry's economic viability and often referred to expert knowledge to back up their claims. In addition, the statements from Green NGO participants reflect strong views by those who put the environment before the industry's economic viability.

> That's where most of the marginal [farming] land is increasing into. It's draining wetlands, and the cost of increasing the area near the coast that's flat or whatever has already seen an immense loss of wetlands. If you are to continue in this industry under those conditions, then I would hope that it's shortened and made smaller very quickly.
>
> (GS 19, Research Scientist).

> It wouldn't work in the Wet Tropics. I think we've seen the end of sugar in the Wet Tropics. I think land has become too valuable. I think you will see it where you have larger farms and I think we'll see corporate farming. I think the social agrarian nature of the industry will fragment at that point. It will be better for land management when the 'corporates' take it over. It will be better for environmental outcomes … and the 'corporates' do that, which is sad but true.
>
> (GP 33, Senior Policy adviser to Reef Plan).

> They gamble with nature. Look at the impact of climate change on the industry. A lot of cane is now growing in low-lying areas … so it's really poor planning. The heat, cyclones, all of that stuff. How is the industry preparing for that as part of their future? How are we going to be here in 20, 30, 40 or 100 years. How are we going to make that happen? It's a huge threat.
>
> (GNGO 10, Green NGO).

> I guess I'm also concerned about the link between some of the big agribusinesses, the big suppliers of petrochemical and base fertilisers and

> government agencies. We've certainly seen it in the past where departments or people within departments or agencies have been pretty much captured by industry and then it's very hard to shift. I'm not saying that's necessarily the case here, but we need to be aware of it.
>
> (GNGO 15, Green NGO).

> We need to be having agricultural systems up here that fit into the landscape, fit into the values of this community and that can demonstrate they are not having significant environmental impacts.
>
> (GNGO 15, Green NGO).

> We should be investing in the more organic approaches to agricultures, the more sustainable ecosystem based farming rather than this traditional big broad scaled monoculture which requires huge inputs of petroleum and energy and labour and so on, often for a crop that is of marginal economic value and very water intensive in the case of growing cane on the Tablelands, it's just ridiculous.
>
> (GNGO 15, Green NGO).

> I've been chatting to Professor Roger Leakey and he just said, look none of that stuff is sustainable. This is a guy that has been working in agriculture most of his life. So as a society and community, we've got to have a major re-think around agriculture.
>
> (GNGO 15, Green NGO).

Below is a rare example from a Reef Protection Group scientist (GS 19) who took a broader view of what might happen if the industry was pressured to the point of no longer being sustainable in Australia. He had also worked quite closely with quite a few growers over many years and had developed positive and respectful working relationships with them.

> You might think it's all positive if you remove the sugar industry now, but there's always some hidden thing. [Let's say] we've stopped farming sugar and we buy our sugar from the dirtiest, most unfriendly climate country in the world. So we subsidise them to produce more of what we just caused a lot of internal grief and family discomfort here. What's the advantage of that?
>
> (GS 19, Research Scientist).

There were those participants (from DNRE and DAFF) who expressed views somewhat in between. Mill and sugar industry association participants also made statements about the industry's need to be profitable and economically viable as a primary measure of sustainability and then included the need to be environmentally sustainable as a matter of logical necessity.

These participants commented on the costs and other economic factors that affect an industry's sustainability and on the importance of appropriate government policy measures. They also spoke of the need for R&D to produce gains in the science and technological advances that make such a big difference for an industry's sustainability now and into the future. The following quotes represent these views.

> The sugar industry has to continue to impress upon government, the need for trade liberalisation. That's the most important thing, because if we don't get reasonable sugar prices, nothing else matters. Secondly, we need to ensure that growers do adopt best practice, because there's often a correlation between adopting best practice and reduction in costs and improvement in productivity. That is important. Perhaps more important than that is to ensure that the genetic gains and our new cane varieties are delivering and realised. Cutting costs for the grower is fine, but they really do need to have additional tonnes of cane, so productivity is very important and getting those genetic gains - and when you look at other industries, for example, the wheat industry, they've been monitoring yield improvement since the eighties and you can actually see the changes in yield over that time, despite the fact that there have been significant droughts and other weather interventions. Whereas in the sugar industry, our genetic gain on an aggregate basis is very difficult to identify.
>
> (IA 29, Industry Association member).

> It's really for government to step back and to not be actively pulling policy levers, if you like, and to focus its work on providing or ensuring that industry has the capacity to have all the necessary information that they should have and to make informed decisions about what they do. Not to try and push growers or millers or anybody in a particular direction in terms of making those decisions, but positioning them so that they can. That's why you have government research and development agenda, the matching levy funds that create SRDC and its equivalent for every major industry. That's a quarter of a billion dollar investment a year from the government's perspective. So it's the number one game in town in terms of raw dollars, and that's all about research and development, dissemination and uptake of outcomes.
>
> (GP 30, Federal Government Policy).

The growers stressed the importance of being able to earn a living and make enough profit to be able to continue on farming, which sums up their main contention of what sustainability means to them. At the same time the growers also expressed an understanding that in order to be viable economically they needed to look after their land and the environment that they depend on for their livelihood. On the other hand, the Green NGO participants expressed views that the agricultural methods of the sugar industry were not sustainable ecologically. They believed that the protection of the natural values of the land was more important than the sugar industry, which they considered to be expendable compared to the natural environment. This suggests

they were less willing to compromise to find ways of a 'win-win' solution and instead were advocating an 'either-or' decision with regard to their preferred cultivation practices.

The locus of where participants situated themselves influenced their views of sustainability. Most of the participants were positioned usually in one of the two opposing sets of views, with some of them somewhere in between. When it comes to sustainability, it seems that 'where you stand depends on where you sit'[39], referring to how a person's view is determined by the group in which they are immersed. In order to analyse and discuss different views of sustainability the background and development of the notion of Ecologically Sustainable Development – from which the abbreviated catch phrase 'sustainability' originated –needs to be examined.

6.4 Product diversification to be more sustainable – an attempt to 'ecologically modernise'

Without a viable (national or international) demand for green sugar that is produced in a particular way there is no economic incentive to produce such a product. There was a great deal of discussion by growers and stakeholders about how the sugar industry could be more sustainable in the future by diversifying the products it produces from sugarcane. Both groups thought this would be a good idea and many were enthusiastic about potential new markets and products. None were so enthusiastic as some of the growers and mill staff from Mossman.

The Mossman mill is land-locked, with smaller profit margins than Tully mill and is under threat of closure due to economic pressures. Mossman mill made attempts to develop other sources of income through a variety of ventures including exploration into niche market opportunities that pay a higher premium for alternative products. One of the growers (MG 9) summed up the issues that mills like the Mossman mill had faced when trying to diversify. The mill had spent a great deal of money commissioning consultants to investigate the viability of schemes such as a cogeneration plant and an ethanol plant. The mill and growers had been very hopeful about the potential development of these schemes in their community. However, both of these potential ventures were deemed economically unviable and did not win government support. The Mossman mill had previously diversified into the development of an aquaculture farm on site, which had also failed. The latest trial venture has been growing cocoa plants with support from Cocoa Australia for a potential 'green' chocolate making factory in Mossman. WWF were also keen to see this venture thrive as the aim was to make organic chocolate with organically grown sugar and hence there would be a market for a change in sugar cultivation

[39] This saying has been attached to several people including Nelson Mandela and former US Secretary of State George Schultz with no citation. It is an old saying or adage.

methods. This venture turned out to be unsuccessful as Cocoa Australia decided not to proceed. These failed attempts at diversification have caused many growers and mill staff to veer away from further investment into high-risk ventures, and focus more on activities that do pay. Examples include focusing on making high quality sugar crystals for the world market, with potential 'add-on' innovations such as the development of their own bagging plant so they could directly export sugar to niche markets without going through the central (single-desk) CSR/Sugar Australia system (which had been mandatory until deregulation of the industry occurred). The comments made by this Mossman grower summed up the sentiments of many Mossman growers and mill staff.

> The point is that [growers] have got to get money for the sugar. The real crux of the thing is, to do anything you have got to get something for the product. Not necessarily just sugar, there have got to be add-ons … or it won't survive. You know they are going to bag some [sugar] this year … and then they are talking about cocoa, well cocoa is going to use about 2,000 tonne of sugar all together so that is not going to help the thing at all. It is another thing to have in the district, which is fine, but is it an add-on? We have got to get this add-on happening, and now. We were on about co-generation and we were on about ethanol and we actually got a grant for ethanol, which I believe they had to hand back because they did nothing. I was involved in that. It was quite a long time ago and we were right up there, we were going to make this happen and it just faded away. That fell in a heap … One of the guys working in the mill, they had a meeting between the management and some of the workers and they were saying, where should we put the chocolate factory and one of the workers piped up and said: "oh, I have got a good place for it, between the co-generation plant and the ethanol plant". It didn't go down real well.
>
> (Mossman Grower 9).

Some younger grower participants thought the future depended on diversification of products from the sugarcane plant. An actively involved young grower from Mossman represented another hopeful view that quite a few of the younger growers shared:

> Sugarcane can be used for a lot of other purposes. We've just got to get our head around what we're going to do with it. They should be working it out now and channelling through to the Governments and all that what we're going to do. That's where the future is. It's diversification, not as in growing other crops, I'm saying the sugarcane, making things out of sugarcane because up here there's not too many other crops you could grow commercially on 1500 acres.
>
> (Mossman Grower 12).

Another young grower from Mossman (MG11) shared these hopes for diversified products from sugarcane but in a more tempered fashion with the need to see results and not just talk.

Concerns about ‘more results’ and ‘less talk’ was commonly referred to by participants who had their hopes raised more than once about the diversification of products from the plant (for example, new pharmaceuticals made through genetic manipulation) only to have them dashed when they did not materialise.

> The biggest hurdle is that people are really interested and keen and excited about them [ideas for diversification] because it sort of gives people a future to say maybe one day we mightn’t be producing sugar from our cane. The biggest problem is people want to see results. They want to see the results of these things that they’re doing. Then basically they want to know when this is happening and maybe, yes, we’ll keep putting the effort into growing the cane because we can grow it for other purposes.
>
> (Mossman Grower 11).

> But sugarcane is one of the greatest converters of sunlight in the world. It is a wonderful factory. It has got all these genes in there and you can manipulate them. What do they say? They always say, genetic engineering, the breakthrough is five years away. It has been five years away for 20 years and it will be five years away for the next 20 years too.
>
> (Mossman Grower 13).

Another grower who was actively involved with the local mill was also enthusiastic about the future of diversification of products from sugarcane. He discussed plans for Mossman to grow ‘specially’ cultivated sugarcane that would be awarded WWF eco-accreditation to meet Japanese market demands for the bagasse (the waste or by-product from processing sugarcane into sugar crystals) to be made into a nutritional high fibre supplement that they used in their diet. This project is yet to materialise. A younger grower from Tully (TG11) also shared his enthusiasm for eco-accredited sugar through WWF and Coca Cola, but talked about the economic realities of a market that was not willing to pay premium prices (to compensate the extra costs of growing the sugarcane in a ‘green’ manner).

> One of the projects we’re doing is, from this year on, we’re going to be making an edible, digestible fibre, which is going to Japan, Okinawa in Japan. And they need traceability, and this eco-accreditation with the panda [WWF], would be a real big marketing benefit, and something we’ll be able to pass on to those growers who become accredited. That’s the idea. With the Daintree National Park behind us and the Barrier Reef out in front of us, and we’re sort of an isolated geographic area, we thought there’s definitely potential there to try and take advantage of that, you know, with the eco-accreditation. This way we can segregate the bagasse of the accredited growers, so we can pay them extra for it … a premium for it. I feel really, really positive about this, you know, our diversification. The fibre’s just so fantastic and it sells for something like $60 a kilo, this stuff, for bagasse, which is just worthless [here]. And over in Japan,

> they make tea out of it, put it into like a coffee plunger, and call it bagasse tea. They actually call it bagasse tea. And three of those little cups that the Japanese have a day is your daily fibre requirement. And I've eaten meals up here that the Japanese would cook, and they use fibre in every course. And it's considered healthy. Well, the sugarcane plant is just so revered in Okinawa. Whereas in Australia, it's [sugar] considered 'bloody death'.
>
> (Mossman Grower 14).

> Well, we've been talking to WWF and people like Coca Cola Amatil have expressed interest in sourcing sugar that's more environmentally sustainable. Well, it won't happen for quite a long period of time, and even if it ever does happen, because it's all good with a lot of these companies until you start talking about the cash, you know. Yeah, and when you start asking how much their premiums are or how much they're prepared to pay for a premium product, they start talking about *sustainability*.
>
> (Tully Grower 11).

From an EMT perspective product diversification could create the means of achieving an industrial advantage in making the industry more sustainable ecologically and economically. The example discussed here contains two of the four core elements of EMT: industrial application of science and technology to innovate through diversification and Green NGO support for industry to innovate. Although there may be potential for a market advantage to adopt this innovation it is has yet to be realised, so the market advantage is missing and government support through policy incentives is also absent. Meanwhile, the sugar industry continues to respond to market, industry and economic pressures – and more recently pressures from Green NGOs – through industry's application of improvements gained via science and technology.

The industry has continued to invest in more science and technology R&D because of gains made through improved yields that have enabled the industry to maintain its economic viability on the world market. Gains made through science and technology also provided improved environmental outcomes for the industry (such as GCTB). Participants from all parts of the sugar industry acknowledged their dependence on science and technology and expressed great faith in its ability to continue to deliver future outcomes that will facilitate the economic and ecological sustainability of the industry.

Even though all of the participants expressed a shared view of the dependence on science and technology for a sustainable industry, variations in the discourse on sustainability became evident during the analysis and were influenced by participants' positions and beliefs about

which science and technology was the most valid. Industry participants talked about two different kinds of science and scientists: one that researched ways of improving industry productivity outcomes; and another that studied the anticipated environmental impacts on waterways and the GBR (referred to as 'reef protection science') from sugarcane cultivation methods. Analysis of this phenomenon highlighted the division between the Industry participants and the Reef Protection participants. This division, discussed in more depth in the next two chapters, affected the uptake of recommended fertiliser practices.

6.5 Interpretations of 'sustainability' using Mol's core features of EMT

As discussed in Chapter Three, EMT helps analyse developmental features of environmental policy that support or hinder the scientific or technological innovation to achieve *both* economically and ecologically desirable outcomes. The analysis presented here is structured according to Mol's (1999) four core features of EMT: the role of science and technology; the role of the market dynamics; methods used by the state to create incentives for innovation; and the role played by environmental NGOs in generating ideas, mobilising consumers and organising public support or disapproval for an industry. An EMT approach provides useful insights into the way that the environmental problem has been managed and why certain innovations are adopted more readily than others.

6.5.1 Science and technology

EMT suggests that 'front-of-pipe' pollution solutions are preferred to 'end-of-pipe' solutions in environmental management. Science and technology are crucial to creating industrial innovations that enable industries to avoid the production of environmental pollution or harm at the outset. Moreover, a crucial aspect of any innovation is that it enhances industrial productivity. In this research, Sugar Industry participants highlighted successful technological innovations that dematerialised natural resource inputs and polluting outputs while simultaneously enhancing improved productivity outcomes. The most successful innovation of this type was the practice of GCTB discussed in Chapters Two and Five. This innovative practice is a good example of the 'win-win' objective of EMT where both the environment and industry win through the application of a scientific or technological innovation.

From the outset the recommended change to fertiliser application practices did not possess the characteristics of an EMT type of innovation. It was not supported by industry, especially the grower participants, for a number of reasons. Firstly, the innovation did not aim to enhance

productivity, but instead the aim to protect the environment was deemed more important than economic costs to industry. Secondly, the innovation was perceived by the Sugar Industry Group as a threat to the industry's productivity. Reductions in fertiliser use were believed to reduce the volume of sugarcane produced, and reductions in productivity meant reduced incomes. Rather than providing a market or economic advantage, the innovation was perceived as increasing costs with no prospect of increasing the price of the product. This in turn threatened the profitability of the industry. Thirdly, industry participants expressed a lack of faith in the evidence presented by Reef Protection scientists that asserted the run-off of nutrients from their properties were to blame for harming the GBR. Based on their personal observations and experience of the GBR through recreational activities of fishing, swimming and diving since early childhood, most of the industry participants believed that the GBR had not worsened during their lifetime. The gap between the policy makers and the industry was hampered by disagreement, poor relations and conflicting knowledges and understandings. In an EMT style of policy development scientists would work closely with industry to produce an ecological innovation that appealed to industry and provided an attractive economic advantage. If the innovation did not offer an economic advantage (or a minimum of no extra cost to production) then the innovation would not be considered as a sustainable form of ecological modernisation.

From an EMT perspective this innovation did not offer a win-win scenario, rather it resembled a lose-lose scenario from the industry's perspective and from the environmental policy makers' perspective. The innovation did not offer a positive productivity outcome or fix an agreed environmental problem and the proponents of the innovation were not able to convince industry of the economic or environmental benefits of the innovation.

6.5.2 Market dynamics

Market dynamics play a crucial role within EMT in stimulating economic reform and innovation. Market demand for innovations of new or modified products that offer improved environmental outcomes stimulate the development and uptake of these innovations. Another economic dynamic that provides environmental improvements comes from reduced inputs of materials and resources that lead to reduced pollution levels. Reduced inputs and pollution may also deliver reduced costs in materials, time and effort, which then delivers an increase in productivity. GCTB again provided a good example for an economic dynamic that was not driven by the (international) market, but nonetheless met the economic EMT criteria for a 'win-win' scenario. This was because it delivered improved productivity from cost savings through reduced inputs, materials and the time and effort expended by growers in crop production, while it concurrently delivered many desired ecological outcomes.

The market demand for Queensland grown sugar, both nationally and internationally, is driven by quality and price. No market signals exist for any changes to cultivation practices aside from those influencing these two criteria. A core requisite of EMT is that a market for a more ecological version of a product already exists or that the market can be fostered through state policies and instruments without trying to artificially construct a market or through any interference with the market itself. In the case of the Queensland sugar industry, the market is almost entirely international and this market had not expressed any concern (or provided any market signals) for the ways that the sugar is cultivated.

Even in the case of the sugar that is grown for the domestic market (mostly from NSW), the same dominating market signals of price and quality apply. In Australia, organically grown sugar only represents one per cent of sales and less than 0.7 percent of the volume of sugar sold[40]. Organic sugar is sold in supermarkets at twice the price of raw sugar while white (refined) sugar is sold at 1.3 times the price of raw sugar. All of the organic sugar for sale in Australia is produced in Brazil where the costs of production are much less[41]. The state is therefore not in a position to encourage industry to change its cultivation practices through market based instruments or incentives. Government could consider funding projects such as the WWF eco-accreditation of 'green' sugarcane grown in Mossman (adjacent to the famous Daintree Rainforest area) if a substantive market, such as the proposed Japanese market for food fibre products made from ecologically grown sugar, could become viable economic investments. If they were viable, projects like these could warrant government support to provide the economic stimulation that would lead to an EMT win-win scenario. But this is a risk that would need to be appraised from both a policy point of view *and* as a commercial financial risk. However, when compared to the proposed expenditure on new Reef Protection legislation[42] the costs of funding projects like these (when economically viable) would be far less expensive, much more productive and much more attractive to industry.

To sum up, decreased fertiliser use, as an innovation, did not satisfy a market dynamic or meet the core economic incentive feature of EMT. This result was interpreted as a 'lose-lose' scenario from an EMT perspective because the innovation met no market demand and was not accompanied by economic incentives from government.

[40] Statistics supplied by Sugar Australia and sourced from AC Nielsen for a full year period up until 24 October 2010.
[41] In Brazil, but they do not pay or treat their workers as well as in Australia. They also do not have the same stringent environmental regulations and policy measures as in Australia.
[42] A reported amount of $375 million was spent by Queensland Government in 2010 on reef protection legislative measures (Queensland Government, 2010).

6.5.3 State intervention

EMT was developed to describe and understand the elements that lead to successful ecological outcomes for industry that enhance industry profitability within prevailing neo-liberal capitalist economies. Bearing this in mind, EMT does not suggest or condone the artificial creation of a market by governments. To do so would run counter to the neo-liberalist economic paradigm. The state can and does use instruments such as environmental audits, standards and certification along with financial incentives and taxes to promote the shift in industrial processes to align with EMT principles. But this is not done in a hierarchical command-and-control manner. Australian governments have generally continued the industrial deregulation process in alignment with neo-liberalist economic policies that began in the 1980s. Since the 1980s, government policy has demonstrated an aversion to command-and-control policy approaches, in favour of policies that encourage eco-industrial reforms with financial incentives. Examples of policy instruments available to government include the waiving or reduction of license fees to pollute when an industry develops an Environmental Management System (EMS) to meet the International Standards Organisation environmental management series ISO 14000/01[43]. Governments can also promote 'good' eco-products through awards, grants, preferential commercial contracts or publicity, such as the Japanese Frontrunner 21 approach discussed in Chapter Three.

Until recently the state continued to introduce incentives for growers to adopt recommended 'best practices'. These came in the form of facilitated learning programs (such as COMPASS[44] and Six Easy Steps[45]), small grants and a chemical certification course (ChemCert[46]), along with strongly promoted policy measures such as Reef Plan to encourage growers to make changes to their cultivation practices. During the research for this study, the state was proposing the introduction of new legislation through the Reef Plan to force growers to change their fertiliser practices. The introduction of legislation to force change in an industry is seen as an unattractive option from an EMT perspective. The use of legislative measures to gain compliance to the adoption of the innovation would be a counter measure away from the use of EMT features that involve negotiation and encouragement to achieve a consensual win-win approach. The state did not use its capacity to apply any economic incentives, however, there were challenges to such state intervention because the market (mostly international) was concerned only with

[43] This is based on the premise that when an industry adopts an EMS to meet ISO 14000 standards it will greatly reduce its pollution outputs in the process. This approach was used by the Victorian State Government in 1997 with frontrunner industries such as Melbourne Water Corporation (MWC) where I developed the EMS for MWC.
[44] Combining Profitability and Sustainability in Sugar (COMPASS).
[45] Refer to Appendix 3.
[46] ChemCert accreditation is a national industry-endorsed standard of competency in the use of agricultural chemicals. Farmers need current ChemCert accreditation, or an equivalent or higher qualification, in order to purchase Schedule 7 pesticides.

quality and price of the sugar crystals. Again, from an EMT perspective the policy choices made here did not achieve a win-win outcome for industry and the state. The industry had 'lost' and would be forced by legislation to adopt an innovation that it perceived as a threat to productivity. The state did not, or could not, use policy instruments to provide incentives for the innovation and chose not to offer economic offsets for losses from adopting the innovation. In contrast, the Reef Protection Group participants involved in lobbying for legislation believed they had scored a 'win' from the introduction of legislative measures.

6.5.4 Environmental NGOs

EMT points to the importance of the role played by environmental (or Green) NGOs in facilitating the ecological modernisation of industry. They have been a critical force in generating ideas, mobilising consumers and organising public support or disapproval for industry. Green NGOs have been working more closely with government and industry on environmental issues over the last three decades, particularly in the countries that have adopted an EMT approach to policy. One of the Green NGOs in this study, Worldwide Fund for Nature (WWF), tried to improve market opportunities for organically grown sugar and the production of eco-accredited sugar. This Green NGO experienced challenges and frustration in efforts to assist the Mossman mill area to change their practices. They discovered the difficulty in locating and realising a market demand for new proposed sugar products (mentioned earlier in grower comments). So far there have been no guarantees, the new products have not been produced and the entire scheme is a very high-risk commercial venture for a mill that has little funds available to invest. There has not been a successful breakthrough for this commercial venture to date although one may occur in the future. This is, however, a good example of a Green NGO working closely with industry to achieve their own desired ecological outcomes while supporting the industry to achieve their desired economic outcomes at the same time. In the process the two parties have developed a good working relationship and greater understanding and respect for each other (evident in the interviewees comments), which is a core feature of EMT.

At the same time there had been pressures from other green activists to introduce legislative measures to force growers to change their fertilisation practices. Green NGOs who took this approach ran counter to the way that Green NGOs would ideally operate from an EMT perspective. Because of the adversarial approach used by some Green NGOs, and because of the pressure they exerted for legislative measures, grower participants believed they had 'lost' in this scenario. Conversely, Green NGO participants believed that the introduction of legislation to enforce growers to change their practices provided them with a 'win'. An EMT analysis

perceives this result in a lose-lose scenario for both parties. Rather than working with the industry, Green NGOs used an adversarial approach and forced legislation on an industry that believed would threaten productivity. But Green NGO participants perceived this as a win since legislation would achieve their desired result.

6.6 Conclusions from an EMT analysis

From a theoretical perspective EMT offers an alternative to both the strong social constructivist and post-modernist approach on one side, and the socio-biologists and neo-Malthusians' approach on the other (Mol, 2000). EMT also works quite well within the current capitalist and neo-liberal paradigm. Important to this theory is the concept that an EMT approach is more likely to gain support for change from industry and that industries have performed better than they did under the old style state regulatory strategies (Mol and Spaargaren, 2002). Manufacturing industries in EM countries have willingly adopted environmental innovations because the innovations did not compromise their productivity and profitability. Instead, there was a market demand that caused the change in their industrial processes to pay off.

Interpretations made from an EMT analysis of participants' perspectives show a method of policy development that did not match Mol's (1999) proposed core features. Rather than a more democratic process of policy development involving policy makers and industry, the policy makers, influenced by Reef Protection Group participants who have direct access to policy makers, opted for the traditional command-and-control regulatory approach with industry. Their reasoning was based on their failure to convince growers to adopt the recommended fertiliser practices. They believed that their recommendations provide cost savings for the grower, do not impact on their cane production levels and will protect the reef from run-off of nutrients to the GBR. They perceive that because growers resist the uptake of these recommended practices that the growers are "recalcitrant, stubborn and ignorant" and therefore need to be forced to adopt the recommended practices through legislative measures.

In contrast, the Industry participants had a serious problem with the recommended practice and from an EMT perspective this heralded two warning bells for the scientists: the scientific innovation was not attractive to industry and there had been a breakdown in communication between the industry and the Reef Protection scientists and policy makers. From an EMT perspective alarm bells should have rung for the scientists about the resistance to the recommended innovation because it was an indicator that there was a problem with the innovation itself or that they were not communicating effectively with the industry. The sugar

industry in general, and its growers in particular, demonstrated that they are not recalcitrant but rather the industry is a world leader in terms of adopting innovative sugarcane production methods and efficiencies. However, the Reef Protection scientists did not listen to the growers with regard to this innovation and dismissed their views. They remained convinced that their science was accurate and they were driven by their perceptions of what constituted sustainable sugarcane growing in the Wet Tropics.

The major barriers to the adoption of reduced fertiliser rates by sugarcane growers were that grower and industry participants believed the innovation did not deliver any market edge or productivity improvement. They thought it was an environmental 'fix' for a problem that they believe they did not create from their current practices. Moreover, they perceived the innovation as a threat to the productivity and profitability of their industry. In contrast, Reef Protection participants believed that they had achieved their goals, however, that had not occurred in a manner that could be considered to be ecologically modern or democratic. EMT proposes concepts that *support* industry to adapt and adopt innovative ecological and economic practices and become more ecologically modern in the process. EMT proffers a more democratic and conciliatory process of facilitating change.

Reef Protection policy makers were striving for environmental policy outcomes that were more sustainable, but on their own terms. They measured their success according to the outcomes that *they* wanted to achieve and were less concerned about the effects of their policies on the industry. The Reef Protection Group participants expressed feelings of justification in their efforts to force 'recalcitrant' growers to conform. As discussed in subsequent chapters, the Reef Protection epistemic community held a belief that they were working for the higher good – that of protection of the environment – and that their actions were therefore noble and for the benefit of society (Kellow, 2007).

The EMT analysis suggested there might be deeper, underlying factors at play. An inductive progression led to a different theoretical framework to tease out the broader context shaping policy decisions. In the next chapter the remaining themes: Science, Technology and Expert Advice, Growers and Farming, Government and Green NGOs are analysed using Foucauldian theory. A Foucauldian analysis of participants' views provides a deeper understanding of the knowledge and power relations influencing the construction of the environmental problem and the policy devised to manage it.

Chapter 7 Mutual Distrust – Some insights from Foucault

7.1 Introduction

This chapter interrogates the mutual distrust between the Industry and Reef Protection participants that provided a dominant, undergirding theme of the research.

Poor relations between these groups stem from many sources, and impinge on the respect each group has for the other's knowledge and beliefs. Informed by Foucault's theoretical concepts and Carolan's (2006d) work on farmer adoption of knowledge claims, this study delves into the ways that trust intersects with networks of knowledge. For example, Reef Protection participants tend to rely on scientific evidence produced by their peers – peers who are often in the business of studying possible threats to, and ways of protecting, the GBR. In contrast, Industry participants rely on scientific evidence produced by industry peers (and other sources) who may not accept negative assessments of the fate of the GBR. This chapter explores mutual mistrust by examining the themes emerging from the interviews: that is, perspectives on Science, Technology and Expert Advice; Growers and Farming; Government; and Green NGOs. The aim of this chapter is to set out the knowledge and beliefs held by participants that underpin their positions and views, while Chapter Eight investigates how these different knowledges engender power and influence the governance of the GBR and its catchments. The analysis of the narratives in this chapter begins with the most contentious and controversial theme: Science, Technology and Expert Advice. This theme is centred on the science that validates each set of opposing views.

7.2 Perspectives on Science, Technology and Expert Advice

Sugarcane growers have a good track record of embracing technological innovations such as regular soil tests, new or modified machinery, minimum tillage, controlled traffic, breeding techniques, advanced pest and weed controls and improved riparian management (Wrigley and Moore, 2006). In general, growers have always looked to new scientific and technological innovations to improve crop yields and efficiency. For example, funding for the Sugar Research and Development Corporation (SRDC) comes from levies from industry of 14 cents per tonne of sugarcane crushed. This figure is matched by Australian Government contributions of five per cent of the gross value of production (GVP), which was estimated at $1.38 billion for 2009-

2010[47]. SRDC contributes to research that not only focuses on productivity outcomes, but also on environmental and social research that affects the sustainability of the industry[48].

Growers voiced many past examples of welcomed technological and scientific advances, but also pointed to innovations they hoped would eventuate in the future. Growers were confident that advances in technology and science would enable them to produce high quality and profitable sugar yields for a competitive global market, despite increasing costs, decreasing sugar prices and the removal of government subsidies. The most welcomed innovations were those providing increased productivity. Any innovations that increased productivity and environmental benefits were equally welcomed. Innovations that produced only environmental gains but did not impinge greatly on crop yields or productivity were also well received and had been adopted by many of the growers interviewed (for example the construction of wetlands and the revegetation of creeks and verges had been adopted by fifteen of the growers interviewed). Unwelcomed recommended innovations included those that were designed to prevent or ameliorate environmental damage that also reduced crop productivity. Any recommended practices that could not deliver a profit (or threatened to reduce their current profits) were an anathema. Growers were particularly averse to pressure placed on them to change their practices when they did not believe that these changes would be successful in rectifying an environmental problem; or in cases where they were unconvinced that their cultivation practices were causing a problem in the first place.

Table 7.1 presents a summary of the Sugar Industry and Reef Protection views on the role and importance of Science, Technology and Expert Advice. The majority of the quotes presented below are from growers who were concerned about the science used to validate the Reef Protection views and recommendations made to growers. The reason why this section is dominated by growers' voices about the science is twofold. Firstly, the growers believed they were not being heard. They felt their knowledge was not considered 'valid' or worthwhile because it was not 'scientific'. As a prior policy developer in the Reef Protection Group of scientists, for example, I had not heard these growers' concerns before. Space to air their grievances thus seemed in order. Secondly, as a prior policy developer I experienced Reef Protection science as accepted without question by government and the general public, while the science that challenged Reef Protection science was denigrated and dismissed. The Reef Protection scientific and other expert knowledge were treated as superior and correct in comparison to grower knowledge.

[47] Cited in Australian Bureau of Statistics, Value of Agricultural Commodities Produced, 2009-2010, Catalogue No. 7503.0
[48] This study has been funded by SRDC.

Table 7.1

Summary of Participants' Views of Science, Technology and Expert Advice.

Science, Technology and Expert Advice	
Sugar Industry Views	**Reef Protection Views**
Science solves problems, makes improvements to industry that produce economic benefits.	Science solves problems, makes improvements to industry that produce economic benefits.
Scientists and experts think they know the answers.	Scientists and experts know the answers.
Scientists will not listen to us about environmental issues and they get it wrong, they make things worse.	Growers don't listen to us about environmental issues – we solve problems that produce environmental benefits.
Scientists are elitist and not interested in what we know.	Scientists know better than the farmers.
Scientists and experts make the rules.	Farmers would benefit from our advice.
They say we are damaging the reef, but we are not. Where is their evidence?	They are damaging the reef and need to change practices or be forced to.

Participants' direct and indirect comments about their 'mistrust', and the validity of the science, appear regularly in the next sections. What becomes clear in the analysis that follows is that growers had mixed views about some scientists and their science regarding the recommended environmental practices. In particular, the majority were sceptical and suspicious of the Reef Protection scientists (although there were some exceptions). Growers who had developed a relationship and come to know and trust scientists were more willing to trial environmental practices than other growers who tended to regard them with scepticism. For example, growers were asked to compare two applications of reduced amounts of fertiliser to the standard single application of a greater volume of fertiliser in an attempt to reduce the amount of fertiliser exported to waterways from run-off. One of the growers from Tully who was willing to conduct the trial had developed a good relationship with a leading Reef Protection scientist who was an expert in the movement of nitrogen through the soil and spoke with great trust in the scientist and his science:

> This year too, I'm planning to split my fertiliser application. That comes from the climate forecasting group, [name of scientist]. He's got the [APSIM] model in there and with my soil types. The normal operation is 140 kilos per hectare per year. According to the computer, if I put on two lots of 60 kilos, I will still get the same production but I'll reduce my export by 30 per cent.
>
> (Tully Grower 12).

In contrast, the majority of growers expressed concern about the validity of the scientific evidence that formed the basis for the proposed changed practices/reduced rates. In short, they were not convinced of the Reef Protection science. Growers commented on scientists' views and beliefs and expressed concerns about the way that scientific data were collected and interpreted. A Mossman grower questioned what made someone an expert in the first place.

> But honestly, all these experts, how do you become an expert, unless you go out and do it? And I think I've probably got more common sense than a lot of them experts. I've also been around long enough to know what's going to happen [in relation to causes and effects of a practice].
>
> (Mossman Grower 3).

The skeptical comments made by a Mossman grower about the science behind the drivers pushing for change in cultivation practices were not uncommon amongst the participants. This grower made reference to two kinds of science: the 'right science', 'proper science' or 'concrete science' as opposed to the 'misleading environmental science'. His comments about environmental scientists 'not taking in the right science' described his delineation between those scientists he perceived to be environmental scientists and the *other* scientists (such as agricultural productivity-focused scientists). The following comments described growers' concerns that Reef Protection scientists were swayed by their own beliefs and thus biased towards finding evidence of environmental harm because of their prior perceptions and beliefs before they even arrived on the farm.

> … you know that the information [regarding runoff to the reef] isn't out there that everybody's happy with … because the whole community isn't happy with the total science of it.
>
> (Mossman Grower 1).

> [Our Canegrowers representative] has just been doing some work with DuPont … over Diuron[49], to try and allay the fears about Diuron because it looked like it was going to go [be made unavailable]. They have got the concrete science to back it up and to counteract the misleading environmental science. I think that was a pretty important thing. You know you need to take your hat off to him for doing that.
>
> (Mossman Grower 1).

[49] Many chemicals used in agriculture have been banned and this then reduces capacity for farmers to control pests. There had been attempts to ban the use of Diuron. Scientific studies were then commissioned by DuPont and Canegrowers Organisation to provide evidence of its safe use in sugarcane cultivation in order to have it approved by the APVMA for re-registration (Australian Pesticides and Veterinary Medicines Authority, 2011).

> It is the perception of the environmental scientist … [that he] is not taking the right science in. Not taking the facts in … and I will bet there is more pollution that comes out of Cairns Inlet than comes out of [cane farms] …you know … what gets washed out of industrial blocks and they are doing it every day.
>
> (Mossman Grower 1).

Another Mossman grower mentioned the trust issue that arose when someone comes onto their land to take samples and then used those samples to the detriment of the grower or the industry.

> I think a lot of scientists don't realise that there is that trust issue. He's got a lot of time to think, hey, I'm just here, I'm just doing my sample [referring to how scientists take singular or intermittent samples and then leave without providing feedback] .
>
> Mossman Grower 15).

Growers expressed their frustration with the way that scientists conducted their work. In most cases the growers were not consulted for their experience or views, and were left feeling their input was not considered worthwhile. A Pilot grower spoke of his experience of scientists (and other experts) making decisions without consulting or discussing the details with him. This grower wanted to be involved in discussions and share information and understanding back and forth with the scientists and experts. He had become frustrated that the scientists and bureaucrats were making decisions without seeking his knowledge or understanding.

> We're not anti-discussion, you know. But we are anti-imposition on us, of what seems common sense that you're not allowed or not permitted to do. That really irks us when there's no apparent understanding or reasoning why we are doing this. If you don't believe that [in what they say], then you say why should I bother. All it does is … you get a lot of people's backs up, a lot of them will just do the wrong thing. That's what we don't want.
>
> (Pilot Grower 3).

The following quotes illustrate growers' views where they questioned the validity of the Reef Protection science. Some of these growers had already adopted new practices to reduce run-off, even though they were not convinced of the science.

> [If the scientists could say] that is what your farm contributes to it [environmental pollution], then you would say well fair enough. You make a point here but it is no good saying this is what happens without having any real basis for it. They can say these are the facts, this is the data. It is always good to say we blame you because you are the majority of the landholders and it must be your fault. Then we're trying to do this and that but until they really come

up with some concrete data and facts that they can blame it onto you until then I reckon they should leave it alone.

(Mossman Grower 8).

No, there's definitely a frustration out there that it just feels like the word is not getting through and suddenly you're always getting blamed for this reef thing and I'm just thinking, I've never seen drains run so clean on cane farms for that long, since this trash blanketing has come in and I said, how can they not say that we're not doing it [the right thing].

(Tully Grower 13).

There needs to be more research into it to really quantify what they're saying. I would say a big thing is a lot more research to ensure that what they're seeing is not natural, because I believe some of these plumes would be quite natural. We had a banana industry congress about two years ago in Townsville and people went down [there with] all puffed up chests and thought this is going to be great, and they blamed the hell out of us. They said we were the worst in the world and we've done this bad and that bad on the Tully River, and we had these huge plumes come out, from people working the ground and all this kind of stuff. But the biggest thing I noticed, they had nothing to back up or confirm any of their allegations. They took a river of similar size up in the Gulf [as a comparison of water quality], which didn't have the rainfall, and never has rainfall events like the Tully River … Like I said, we do a lot of boating, we don't want to see the environment hurt in any way, so we make sure we do the best thing we can.

(Tully Grower 21, with cane, bananas and cattle).

I would like them to do some real trials and probably check into our farms and check the national parks with the scrubs. I think a lot of damage comes from wild pigs digging ... You see some creeks coming out of the mountains where there is no farming, just running red after a heavy down pour, and that is pigs digging up there. I think now with our trash blanket, stool splitting fertiliser, you know we're not working ground, I think it would be very minimal run off on today's type of farming. There is no one who burns their tops and works all their greens, probably in the old days I would say we would have had a lot of silt run off in the high rainfall, but now there's trash blanket. We are not working the soil, we are stool splitting so there is very minimal soil there that can get washed off even in heavy down falls, so I don't think that is a real issue.

(Tully Grower 25).

So they are selling themselves as water quality people. I said you can blame the paddock but I said you come and measure, put a measurement on the bottom side of the road there and put a measurement in the cane paddock. There is no bloody washing in [our] cane paddocks anymore. It doesn't happen. I mean you can't afford to lose any soil out of your paddock. No one lets that happen.

(Tully Grower 26).

The following quotes from a Reef Protection scientist and a government extension officer questioned the validity of some of the science and its practical application. These sorts of comments are uncommon from participants in the Reef Protection Group as they are not part of their dominant views about science, but rather reflect the perspectives of the Sugar Industry Group.

> There's a bit of a chasm [in the data] and to date all we've relied on is modelling outputs to scale that up and give us an indication of what type of responses we might elicit with a change. The reality is those models … some of them you can drive buses through with some of the assumptions and gaps in the data that we have. So I agree, I think there's a real issue there around actually quantifying or demonstrating the economic and environmental implications of the practices we're actually recommending.
>
> (GE 5, Government Extension Officer).

> My understanding of the GBR is yes, it's changed, and there are people who will tell you they have irrefutable evidence, but there is still a debate in my world. There is still a debate about whether there have been significant changes in in-shore reefs and water quality that we can determine is due to European influence. Now, all the information is out there saying sediment run-off and everything has gone up five times since Europeans, but they're only models. They're only predictions. They're only estimates. There is no proof. All you can [say] is well, 60 million cubic metres or kilometres of soil flowed off this, but those are predictions.
>
> (GS 19, Research Scientist).

> The farmers want to see what it is [the real cause]. [They say] you show me my dirt on that coral. You show me my fertiliser causing that toxic bloom. You show me my farming practice causing that there for that reef. It's still difficult to do that. If sugar cane had a C^{13} label in dirt that ended up [on the reef] - and that was the only source of the C^{13} on the reef, and you could show that C^{13} was incorporated into corals and caused their death[50], if you could do all of that, I'm sure the majority of them would say okay, but they haven't been shown something which is irrefutable and simple.
>
> (GS 19, Research Scientist).

Mossman grower participants made comments about the fact that 80 percent of the shire they lived in was 'locked up' in national parks that comprised almost entirely of hills and slopes in the upper catchment areas. Even when a report detailed that it was these higher-gradient sections of landscape that contributed the majority of the sediment (Bartley *et al*., 2004) and possibly significant amounts of nutrient as well to coastal run-off, it was not reported in the

[50] C13 label refers to radioactive Carbon 13, used to trace the movement and pathway of a 'labelled' (or tagged) carbon atom through the environment.

media and there was no public acknowledgement or apology made to growers as a consequence of the new findings. Some growers expressed bitter disappointment that they could be publicly accused of harming the GBR, but when new contrary evidence was found there had been no public announcement to this effect and thereby no change made in the general public view about growers. A Tully grower was particularly upset about this issue.

> Even with our work done at this level [referring to special drainage undertaken to reduce run-off], they're still bagging us, and that's the trouble. It's proven with water sampling, bulk of the contaminants were not coming from cane farms, it was coming from the natural environment. That's what it's about, natural environments and also townships. That's where the biggest problem lies I think.
>
> (Tully Grower 5).

Most of the Industry Group participants shared a common view about the range of possible sources of sediment and nutrient run-off to the GBR. Participants referred to the run-off of nutrients from urban centres, including stormwater pollutants such as garden fertilisers, oil, and chemicals and nutrient loads from sewage treatment plants (STPs). Many growers and industry participants, referred to the 'red' run-off that they believed originated from the upper slopes of the rainforested areas and national parks.

> I think it's grossly exaggerated. I've seen some of the preliminary results of the water testing in the river systems up here. And it clearly shows that the nutrient run-off is coming from urbanisation, not agriculture. Because there's nutrient, nitrogen and phosphate is coming out of the national park, 'cause one of those testing stations is on our farm here. It just tests the water straight out of Daintree National Park, and it's tested again before Mossman, the township, and again afterwards. There's a slight increase in sediment and nutrients from the agriculture, but not a lot. And then it jumps right up, and that's probably the nutrient anyway would be coming from the sewerage plant. But you know, we've got subdivision going on around the place. It's unbelievable, the amount of dirt that washes out of them. And as an example, down at Wonga Beach, a farmer down there, [farmer's name] had two creeks running through his farm, and he was 100 per cent trash blanketed. A big storm came at the end of the year, and they'd done a subdivision, rural residential subdivision up on the side of the hill. And the creek that drained that subdivision, that went through his farm. You could walk across it. It was just about solid mud. And what was draining off his cane farm was almost clear water. That's just the difference, you know, but the same people who were living in that, or just about to build in that subdivision, would be pointing the finger at cane farmers for polluting the reef.
>
> (Mossman Grower 14).

> But, yeah you get those big deluges – I have seen it ample times now, we might get an inch of rain here and it has all happened above us, I have got a sister who lives on the Tablelands and she said it is absolutely pouring, within 18, 24 hours that Tully River is running lipstick red. You know that isn't because it has happened here, it's up there. So what I am saying is yeah, certainly our industry would contribute but yeah you know there is cattle area above us, there's natural slope above us.
>
> (Tully Grower 30).

> They are saying that fertiliser leaches and I say, if you've got this paddock here, can it really leach from here to that creek right over there [several hundred metres away]. When you put sewerage into the ground – we've got our own system here – you can be 50 metres away from a water channel, and they say that that's filtered water.
>
> (Tully Grower 7).

> Regularly, with heavy rain, you would get red mud coming down the Mulgrave, but it was always coming down from higher than where the cane paddocks were. Basically, the cane paddocks got blamed, because the highest cane paddocks are in the volcanic soil area [on the Tablelands], which could contribute red mud, but it's in the river before it gets there [on to the cane paddock].
>
> (IM 11, Mill staff)

A Mossman grower had undertaken many trials and adopted a lot of recommended practices, including ones that had cost him a great deal of time and effort and some that have failed. He made a point about the fact that regardless of recommended practices there were uncontrollable variables (such as rainfall) that growers have to manage for that experts do not fully appreciate.

> You can have all the best practices and best machinery and everything and it still boils down to sunshine and water [rain]. Nobody can control that and nobody can even tell us about it.
>
> (Mossman Grower 2).

Two of the most active and innovative young growers (both third generation growers) from Mossman believed that sugarcane cultivation was not the main source of run-off to the GBR. One of these Mossman growers said he was doing everything possible to look after his soil and his future sustainability. He had tried almost every recommended practice and was tired of the accusations made against cane growers for run-off issues that he didn't think were deserved. The other Mossman grower made a comparison of what he thought came off a farm compared to the same area of land under housing development.

> We're doing our best with preventing run-off. There is not much difference between the water that flows from the property above us to the property below us. We're doing everything we can to prevent it. We have a WQ monitoring station on that part of the Mossman River that is on our farm. We haven't had any feedback yet about the results, but according to the media we are dumping heaps of fertilisers and other chemicals into the rivers. I don't think there is any leaching of any chemicals or other environmental problems. I don't think that growing sugar is contributing to problems on the reef. Green cane trash blanketing has really reduced run off from farms. I think that towns could do a lot more to reduce *their* run-off.
>
> (Mossman Grower 10).

> Like, we try to change things and we are trying [new] things. I don't know for a fact, but I'd say if you'd had ten acres of cane land compared to ten acres of houses, I know which one would be putting out far more toxic waste than a cane farmer would be doing, down the toilet and down the sink, down the gutters.
>
> (Mossman Grower 12).

The narratives include many examples of growers who have trialed scientific innovations on their properties. Innovations that have been demonstrated to produce the desired outcome and improve productivity have been well received and readily adopted by growers. Innovations that do not deliver improved productivity are not as popular with growers unless they have been shown to deliver other desirable outcomes such as the amelioration or prevention of damage to the environment. Innovations that were the least welcomed were those that were costly and did not convince growers that they would deliver the desired outcome. Growers commented that experts who worked closely with their industry and had a good understanding of the agronomics of the industry were more likely to propose sustainable innovations. In contrast, they perceived experts who were more partisan in their views to be less knowledgeable about their agronomic practices. Reef Protection participants, on the other hand, considered the experts to know more about the 'environmental problem' than the growers and many of them perceived growers to be ignorant and stubborn, thereby warranting a need for legal intervention.

7.3 Perspectives on Growers, Farming and Government

This section combines an analysis of each group's perceptions of growers and their farming methods with their expectations of the government's role in supporting the industry and protecting the environment (see Tables 7.2 and 7.3). The participants regularly spoke about these two themes in unison, which is why they are collectively interrogated here. Industry views of government policy were expressed in terms of how farming is recognised as contributing to society and the economy. Reef Protection views of government policy were discussed in terms

of how they perceive growers and their farming methods affecting the environment. In short, Industry participants claim they contribute to the regional and national economy while improving[51] and caring for the land and yet the government thwarts them with regulations and policies that made farming very difficult and uneconomical in order to appeal to 'green' voters. In contrast, Reef Protection participants claim growers are harming the environment, are not contributing as much to the region's economy as eco-tourism does and are thereby economically expendable. Given this context, government needs to take action and regulate in order to protect the environmental values of the GBR and the Wet Tropics region.

Table 7.2

Summary of Participants' Views about Growers and Farming Practices.

Growers and Farming Practices	
Sugar Industry Views	**Reef Protection Views**
Farmers create income and work, other economic activity and create food.	Farmers create sugar (inference is that it is not good for you).
Farmers improve the land.	Farmers are environmental vandals.
Farmers care for the land.	Farmers are ignorant, stubborn and recalcitrant.
Farmers create towns and community and used to be the unsung heroes.	No need for farming in the Wet Tropics. Eco-tourism is better, with more income.

[51] Improvements referred to include examples such as land that was once swamps is now productive, habitable and more pest-free.

Table 7.3

Summary of Participants' Views about Government.

Government	
Sugar Industry Views	**Reef Protection Views**
Government does not support us like they used to.	Government is responsible for people and environment.
Environmental policies make our costs go up, but our profits are going down.	Government needs to protect the environment
Regulations are not necessary. They are expensive and we bear the costs.	Government needs to be firmer and needs to introduce regulations.
Government has gone over to the greenies' side. The greenies have the power over government now.	Government must heed expert advice from scientists who produce evidence.

Reef Protection Group participants expressed their perceptions about growers and the sugar industry often using derogatory terms and phrases to describe growers: 'peasant-like', 'ignorant', 'uneducated', 'old fashioned', 'stubborn', 'highly conservative', 'held back by traditions', 'irresponsible', 'reliant on government subsidies', 'poor businessmen' and 'dinosaurs'. In contrast, the government extension officer participants who worked closely with growers on a daily basis rarely used these terms or phrases (although several of the participants who worked for government did use some of these phrases to describe growers during the interviews). These derogatory remarks were most commonly made by Reef Protection participants who had not been closely involved with growers or sugar industry members and had not developed regular working relationships with them. A senior level government policy maker provided examples of perceptions held about the sugar industry and growers and their knowledge and understandings.

> … and the farmers weren't pleased when I said that they were old style trade unionists, how they operated, the millers were pretty old fashioned too.
>
> (GP 26, Policy maker).

> I can understand that in a way, because a lot of these people were peasants in Sicily and other places and to be a farmer, it's huge prestige and a lot of money until recently. These people valued their position and didn't value learning. They didn't do any business planning because they didn't need to, they didn't borrow, and they had no idea. Their idea of planning the business was to get the next tax concession to stop paying tax next year. So they all ended up with

> harvesters, which were twice as many as they needed, they've all got seven tractors and so on. Anyway, that's what I believe is the industry.
>
> (GP 26, Policy maker).

> And that's the way it goes, I think. The old man holds the strings and they have this tight family structure in many places. One of those worthy things that come from southern Europe, I suppose. And father rules the roost and the kids have good ideas, but they can't put them in.
>
> (GP 26, Policy maker).

> The louder you shout, the more likely you are to win the argument. But that sort of attitude will die out with the old men and the young people are getting better educated. I think people are beginning to realise that they have to go through at least until year 12 at school and it wouldn't help to do some business course either, if they're going to run a farm, and do some agricultural training, which many of them do.
>
> (GP 26, Policy maker).

> It's just medieval, but that's the way people still farm in the southern Mediterranean. They're good people. They're lovely people. It's just a matter of there are other ways to do things and the world has moved on.
>
> (GP 26, Policy maker).

The Reef Protection participants who were involved in eco-tourism were on advisory committees that provided recommendations and input into policy development. One of the participants working in the eco-tourism industry provided an example of how views about the negative impacts of growing sugarcane were reinforced in the community on a daily basis, and another eco-tourism participant believed there was a discrepancy between government support for farmers versus the tourism industry. Both of the comments made below were part of a wider perception that sugarcane growers continued to be supported by government[52]. Reef tourism operators were disgruntled that they were required to pay a Reef Tax (designed to have users of the GBR fund its protection) while growers, perceived as causing damage to the GBR, did not have to pay a Reef Tax or other equivalent payment.

> You're talking 1.2 million visitors driving along that road a year that have possibly got a tour driver saying, these cane fields are wrecking our reef. I've heard it on a number of occasions.
>
> (T 27, Tourism operator).

[52] References made to grower subsidies were incorrect. Growers have had their subsidies void during the 1980s and 1990s as a result of national changes to neoliberalism and deregulation and through international trade agreements.

> Certainly, primary producers seem to have access to subsidies out of government a lot easier that the tourism industry.
>
> (T 22, Tourism operator).

Many Reef Protection scientists, bureaucrats and experts believed that growers and the sugar industry were abrogating their responsibility for the damage they were accused of causing to the environment, and that they were not being brought into line to change their practices. A scientist participant was of the view that the industry's lobbying strength allowed them to 'get their own way' with government and held the perception that the industry needed to be forced to change their practices.

> … my feelings on the sugar industry [are] they abrogate responsibility, they don't accept responsibility.
>
> (GE 13, Government extension officer).

> So some of the ones, as I said earlier, are either reluctant based on tradition or whatever else to change practices and they're the ones that need to be brought into line.
>
> (GS 31, Water quality scientist).

> My impression, and it's only an impression, is that they've been able to get their way in such a way that they haven't had to change practice because the industry has been strong [in their dealings with government].
>
> (GS 31, Water quality scientist).

A senior government policy advisor expressed views that demonstrated a division in knowledges, understandings and perceptions between the Industry Group participants and the Reef Protection Group participants. There was a continual reinforcement of these sorts of views when they were regularly repeated in everyday contexts:

> Have you ever sat on one of their boards [meetings]? They are archaic. They breach every corporate law and act. They run it like a family business. They're not transparent, they're not accountable, they're not anything. The quality of their managers – their managers are somebody's brother's cousin. The nepotism - It's just beyond anything I've ever come across. Do I think they will be sustainable? No I don't. I think they will crash and burn. I don't think they will learn. It smells like a dying industry. Currently, it's a dinosaur.
>
> (GP 33, Senior regional policy advisor).

> You're dealing with a bunch of people who aren't terribly business like … or educated generally and just can't make that leap.
>
> (GP 33, Senior regional policy advisor).

Government was viewed by many Reef Protection participants as not doing enough to cause growers to change their practices and be more ecologically sustainable. Simultaneously, government was viewed by the Industry participants as leaning too far towards supporting 'green' demands while withdrawing their support for the industry. In the next section growers' views about government policy are analysed.

Grower participants voiced a strong sense of their contribution to the Australian economy and their belief that there were sections of the government that still recognised them for their accomplishments. However, there were also many growers, like this Tully grower, who commented on their fears and perceptions that other sections of the government wanted to get rid of them and didn't appreciate them or Australian farmers in general.

> No, I don't think it's possible to go another generation just because I don't think our governments in Australia value farmers [non-corporate/family farmers] to the point that they used to years ago.
>
> (Tully Grower 11).

A Mossman grower expressed concerns that were shared by many growers from both Tully and Mossman and the Pilot grower group. They believed that the government was 'against' them or had abandoned them. Grower participants said that government was now more concerned with the green and urban voters than the farmers and was bowing to public pressure in order to look like they were doing something about the GBR issues. Many of the grower participants felt this was unfair as they considered that there was still insufficient evidence that their farming practices were causing damage to the GBR. Growers felt the government no longer had the same commitment to support farming in Australia. This view stems from the change in attitude to farmers and farming that accompanied the swell in concerns about the environment since the 1970s (which is discussed in more detail in Chapters Two, Six and Eight).

> I just feel like the government isn't helping us. Actually, I think they're making it harder for us to do anything with the red tape they put in front of us. … that's my biggest concern. I actually think they want us to fold-up.
>
> (Mossman Grower 12).

> The environment's just a political tool now so the more policies political parties are going to put out… they're hoping to get more votes and they couldn't give two shits if it's a good or a bad policy, it's just a political tool. There'll be regulations and then you'll get some 'company man' who works for the EPA will enforce them and really, it's not going to affect anyone who voted for the political party and all it's going to do is affect the farmer.
>
> (Tully Grower 1).

Grower participants made various comments related to a perceived widening of the gap between themselves and government, and this was exacerbated by their fears that regulations were about to be thrust upon them. Growers said they didn't see the need for the 'big stick' approach as they had already adopted many recommended environmental practices and were 'doing the right thing'. A Tully grower remarked on his experience and views of federal government bureaucrats when a group of them had visited his farm. His comments demonstrate some of the perceptions that growers have about bureaucrats as dictatorial people who do not make an effort to engage in or find out about the growers' experiences and views.

> I hated it [when] someone came here with a big stick and tried to stand over the top of us… Even though we were [already] doing it, and some people got paid to do these silt traps and do all this because of this drainage scheme that was started. Someone came in wheeling a stick saying that you've got to do this and you've got to do that and – but we'd done it. We didn't get one razoo[53] out of it, not that we went and pushed for it because I didn't want someone coming here and saying you've got to go and do this. And sometimes they're overboard. Some of the people that you talk to on the ground, their representatives, they're just unapproachable. They're just – just bureaucrats, basically, unapproachable… so unreasonable.
>
> (Tully Grower 14).

A sugar industry association participant expressed his frustration at the attrition that has occurred in the direct line of communication they used to have with government. The industry association now had to communicate through the Natural Resource Management regional bodies (NRMBs) instead of directly with federal government bureaucrats. He considered the NRMB staff to be the equivalent of another tier of government, except he believed that they made communications and negotiations even less effective, and instead were another layer of bureaucracy to work through.

[53] 'Razoo' comes from the Australian colloquial phrase 'brass razoo' as a gambling chip or "non-existent coin of trivial value" and is commonly used in the expression "I didn't have a brass razoo", meaning the speaker is out of money (Macquarie Dictionary: Australia's National Dictionary Online [electronic resource], 2009).

> Government doesn't talk to us very much anymore. It all goes through NRM regional bodies… and I think it's a flawed model. And it's like … guys [government representatives] you've got your head up your arse. You just don't know what's going on. It's just another government body we have to deal with.
>
> (IA 9, Sugar Industry Organisation).

Industry participants expressed their frustration that government had 'double standards'. Landholders were expected to take on further environmental management responsibilities while government was seen to be evading its own environmental and pest management responsibilities on crown land. Many growers spoke about the environmental damage caused by wild pigs living in the National Parks. The National Parks are the management responsibility of the Queensland state government. The vast majority of National Park land in the Wet Tropics (approximately 80 per cent of the land in what was once Douglas Shire is under the auspice of the State National Park management) comprises of mountains and hill slopes, which were found to be the most significant sources of natural erosion and soil disturbance ending up in the waterways (Bartley *et al*., 2004). Further soil disturbance and damage caused by the wild pigs harboured in National Parks only exacerbated the levels of erosion and run-off from these sources. Participants from all groups agreed about the enormous amount of erosion damage caused by wild pigs in the region. Comments like these from two Tully growers and a Mill participant stressed that when it came to pest and weed management the government did not look after its own land properly yet expected landholders to manage pests on their land and bear the costs as a legislative requirement.

> There's no feral pig control, we're doing it for them. All that hymenachne[54] is coming out of state forests in to our property. I keep spraying it every year, every year, and you can see where it's coming from but I can't go in there … in to state forest. They don't put any money in to [managing] it.
>
> (Tully Grower 22).

> You look at they put legislation on us that we got to control all our pests and disease and stuff like that. We're not making any money. We got, [Siam] weed on this farm here, we got a patch of it. We got to control it. I can tell you now, if I'm not making any money, you think that's the last thing I'm going to be bloody worrying about. You want to control it, go and control it yourself.
>
> (Tully Grower, 4).

[54] Hymenachne is a semi-aquatic perennial grass that has become a major weed of wetlands, flood plains and sugar cane crops of northern Australia. It has invaded freshwater wetlands, flood plains and river banks. It forms dense infestations, displaces native plant species, reduces biodiversity and threatens native wetland habitat (NSW Department of Primary Industries, 2009).

> I always think the best way of doing it is rather than the big stick approach, I always think that people do it [more] for education and incentives. The big stick approach never works. They can't even police wild pigs in the national parks, and they're doing more damage than anything in the national parks. Well up here, anyway. It just creates a bureaucracy that probably otherwise wouldn't be needed. I think if you make it too bureaucratic… Effective education plays an important role.
>
> (IM 1, Mill representative).

On the other hand, there were comments made by a few government extension officer participants (Reef Protection Group) who thought that the development of more regulations to manage the application of fertilisers on farms was not a good idea and would prove ineffective. Instead, it would erode confidence in government and their staff and make future work with growers much more difficult. An example of this perception came from a government extension officer participant (GE12) who worked in the region and was concerned that he might be placed in a regulatory role. He said that in his current role he was expected to help, cajole, educate and bring farmers on side and in a regulatory role he might be required to fine them as well. He said it would make life in a small community very uncomfortable.

Industry responses were not always straightforward. For example, a grower may have complained heavily about a policy that pressured him to change practices, but still adopted that practice due to pressures from media, public comments, family members, friends or peers – or because the policy may have been accompanied by a financial incentive such as a government grant. Despite disagreement and vehemence towards some knowledge claims growers have adopted some, or part of, recommended practices due to powerful influences exerted upon them.

7.4 Perspectives on Green NGOs

One of the core features of EMT is the role played by Green NGOs. Some Green NGOs work closely with government and industry on environmental issues while others act as powerful lobbyists to pressure government. Green NGOs are often a critical force in generating ideas, mobilising consumers and organising public support or disapproval for an industry and its practices. Participants' perceptions of the role played by Green NGOs, and the influence they have in aiding or impeding the adoption of recommended practices, are analysed in this section (see Table 7.4).

Table 7.4

Summary of Participants' Views of Green NGOs.

Green NGOs	
Sugar Industry Views	**Reef Protection Views**
Greenies (WWF) can be helpful sometimes, such as for eco-accreditation for potential new products from sugarcane.	WWF is working with Mossman mill and growers to find eco-markets for new products from eco-accredited sugarcane.
Greenies are adversarial and accuse us in the media of harming the GBR.	Growers are killing the coral reefs with their sediment and nutrient run-off.
Greenies cannot see what we have already done for the environment, such as GCTB.	Growers do not do enough for the environment and think more of profits.
Greenies do not understand what we do, listen to incorrect science and will not listen to us.	Growers are stubborn, ignorant and will not listen to good sense, the scientific evidence or us.

Grower participants had mixed responses to the pressures exerted by Green NGOs. Some growers felt they should ignore what the Green NGOs said since their representatives did not seem knowledgeable. Others were upset about reports in the media where Green NGO representatives had accused sugarcane growers of harming the GBR. Most grower participants believed the public had been misled by Green NGOs who stir up media hype using information that had not been validated. The majority of the grower participants felt that 'greenies' were generally adversarial, with a very limited understanding of the whole picture, and had a tendency to focus on specific events in isolation. They lamented that once Green NGO representatives made statements that became news items then the damage had been done and seemed impossible to undo afterwards, regardless of any evidence to the contrary. Most of the growers were convinced that media reporters and the general public were more likely to believe Green NGO representatives rather than grower or industry representatives. Growers and other industry representatives were especially upset when accusations made about them were later found to be incorrect by some of the Reef Protection Group scientists. These discoveries were not accompanied by public apologies or media coverage. The thing that upset them the most was when growers were reported as environmental vandals or uncaring and unthinking people who were more interested in profits than the health of their land and the GBR. The following quotes are examples of participants' frustrations at being blamed for harming the Reef while feeling strongly that they were not to blame.

And then of course Menzie's grandson who did the narration on that show [For the ABC TV documentary "Muddy Waters"] and he said, "well [grower's name] might use the right amount of fertiliser, others in Tully aren't". He said, "the fertiliser in Tully in the last ten years has doubled". They got that [figure] from the fertiliser companies, but they forgot what happened is Tully Mill went from one million tonne of cane to two million tonne of cane, which is the dry areas, and the bananas went from 400 acres to 4,000. So in actual fact, for our area, we are using less, but she turned it around. It's not good reporting, in my opinion. Let's stick to the truth if we're going to talk about these things.

(Tully Grower 24).

No, there's definitely a frustration out there that it just feels like the word is not getting through and suddenly you're always getting blamed for this reef thing and I'm just thinking, I've never seen drains run so clean on cane farms for that long, since this trash blanketing has come in and I said, how can they not say that we're not doing it.

(Tully Grower 13).

Back then it was the big fiasco about the reef. We were killing the reef. We're killing the reef. And that's all it was. Well, what gets me, I'd hate to see the run off that comes off Cairns or Townsville, off those streets that goes down the gurgler, goes … straight out to the ocean. All the oil off that bitumen and all of that garbage.

(Tully Grower 15).

Because they're targeting agriculture for the things [problems] of the reef. Up the Daintree there's no such thing as agriculture and they still get the same sediments out there.

(Tully Grower 22).

Here, in the Douglas Shire, when you look at the amount of area over the whole shire that is actually cultivated it is very minimum to the total area. You know 80 per cent of the shire is locked up so that virtually means that 80 per cent of our water catchment is coming from pristine scrub. [Any] other little bit [of sediment] that is going in there is not going to do any damage at all, because all it is going to do is the mangroves are going to pick it up because they are a big filter. The bit that goes out to sea is minimal. When you have a rainfall event it is so [obvious] you can go out and see the silt is two kilometres out or whatever. Well the next day you get south-easterly winds and it blows it all in. It blows it all in. So, you are getting the flush of the tide, it is really minimal impact as far as I am concerned.

(Mossman Grower 1).

Minimal, very minimal [sediment or nutrient coming off caneland]. I wouldn't say none, but I think the creeks are always dirty before they get to our place. But as far as I can see, yeah, its very minimal… It all comes out of the scrub.

> They're a little bit hard on the farmers. They're not taking into consideration what people are doing. Look at the houses [being built] and the things they do, and the things they throw in their sewerage, you know, the works. I see what they do up here anyway with the houses … there's always bare dirt up here.
>
> (Mossman Grower 2).

> But I take note a lot when it's raining. There's no farm lands up further [above our land], but the river's still running dirty, and it hasn't hit the main, where we work, and so you tell me.
>
> (Mossman Grower 4).

> When you hear it all, it is always the farmers that get the blame but no one has got the money to waste it and no one looks at all the sub-divisions which go up in Cairns or even here in our district. I reckon there is a lot of run-off coming – more run-off probably from urban development than what it is really from farming. It is easy just to blame the farmers. We see it here. We have the national park right behind us. There is no one else, the creek comes out of the national park and the amount of dirt which comes down with the creek from the national park. You see where the dirt comes from. We see that there is not much dirty water running out of the farm so there's a lot of dirt, soil actually coming out of the mountains. You can see where it is coming from. I think it is easy to blame the farmers on it and say, it is your fault.
>
> (Mossman Grower 8).

> But the farmer was an easy target, he got blamed for everything. It is not my intention to send my soil down the river. You can't afford to put fertiliser on soil if it's washed out to sea. We have always done soil samples and I worked on the supposition that you put on what the plant required to produce a decent crop. That was how I always worked on there [my land].
>
> (Mossman Grower 9).

This Pilot grower (with a property close to the City of Cairns) had adopted most of the recommended environmental practices and was open to discussions with Green NGOs rather than an adversarial approach.

> We've got the Greens on one side saying you're doing this and this and this wrong, well, okay, let's sit down and talk about it. They have to come over a little bit and we have to go a bit. We've got to meet in the middle. But that's the problem. They say, no, we're not going to meet in the middle, because this is what we want. There has to be talk and consultation, but not so much that us farmers get so depressed. It's got to be sensible talk. We don't want to be talking to someone who says, no, that whole paddock should be all trees, because that way it's going to beautify the place, and all this. No, let's be sensible about it; let's be sensible and say, okay, we're going to start doing this …

(Pilot Grower 1).

The best example of a good working relationship between the industry and a Green NGO was between the Mossman mill and WWF. They had developed a venture to make an accredited brand of sugar endorsed by WWF for a specialised Japanese health food market.

> We would love to see them all move to this eco-accreditation… That's been the difficult one, up until now, to be able to say to them, look, you become an eco-accredited farmer and you will get an extra 30 per cent for your crop. But up until now, we can't say that, and it's still difficult to say that, until we know that we've got clients or buyers who say, look because we've become an eco-accredited sugar producer, we will give you 30 per cent more, and it's very difficult in order for people to do that until it happens. That will happen, I'm sure, and I know up here, a lot of the growers are very keen to move towards that eco-accreditation. Personally, I think it's a great idea. I would love to have all of our cane come in and it's been eco-accredited cane, because I know that we would be able to get some premiums, but until that happens - it will happen, but slowly.
>
> (IM 28, Mill staff).

Growers' perceptions about Green NGOs and their representatives were often negative except for instances where they spoke of eco-accreditation opportunities that could lead to niche products from a sugarcane product that paid a premium. Of the three different Green NGO participants who were interviewed for this research, two lived locally (GNGO10 and GNGO15) and all of them had been raised and lived in a city. Some of them made comments that demonstrated an active dislike of growers and used analogies or descriptions of growers as a sub-culture that were denigrating, as demonstrated in the first comment below by GNGO 15. These comments demonstrated derogatory perceptions of growers, the sugar industry and their farming methods in general.

> When I drive through cane country, I see a lack of aesthetic, because when you look at the homes that most of the growers live in, they are just what I consider to be quite ugly buildings stuck in the middle of a cane paddock with very few attempts to create a beautiful garden or a beautiful space. So to me, that's backed up by what I see when I drive through cane country, because I see a lot of aesthetic in the dwellings, which is a reflection of the mindset and attitude and cultures within [which] growers probably live.
>
> (GNGO 15).

> I think in Queensland the sugar industry is a little bit – yeah – has a history of being very conservative. It's essentially being defensive. Defensive of where it's coming from.
>
> (GNGO 16).

> Cane growers traditionally come across as a pretty conservative group and that's reflected in all sorts of things. I've seen it in terms of denial around the impacts of cane industry on water quality, on climate change, getting people like Bob Carter[55] up as your guest speaker. It just reinforces the fact that they are entrenched in the past and not particularly accepting of science or where the world is moving to, and that's a dangerous space for any industry to be in. If they were smart, they would recognise that is one of their weaknesses.
>
> (GNGO 15).

A Green NGO participant expressed a belief that growers were just not admitting their role in the damage they caused to the GBR. He believed that the growers were burying their heads in the sand. This Green NGO participant did not think that growers understood risk management or how to plan for risks and that they grew their crops in a 'willy-nilly' fashion, implying that they gave little thought to the planning and effects of their cultivation practices.

> It's clearly known that one of the greatest recreational users and appreciators of the reef are often a lot of sugarcane farmers. So it's fascinating that sometimes – and honestly, if they really spoke from their heart and soul, they would know that changes are happening in the reef. It's just a shame that they're not appreciating maybe that they and some other agricultural industries are responsible.
>
> (GNGO 16).

> I think in some cases, if a sugarcane farmer could demonstrate that they are – recognised all the major risks and they've got an action plan to respond to each of those risks, then I think there'd be a lot more respect and value of their activity. I suppose while there's a sense that it's just being grown willy-nilly and there's no sense of managing the risks, then yeah. That's where the conflict comes.
>
> (GNGO 16).

Two Green NGO participants (below) made comments on some of the reasons why they thought the sugar industry and growers were generally backward in their practices and views. One of them thought that a farming culture where farmers were still answerable to their fathers played a role in holding them back and the other thought that a lot of the blame laid with the State government departments that were still 'twenty years behind'. They implied that the growers needed help to follow a more *acceptable* method of 'farming properly', that matched their own version.

[55] Professor Bob Carter is a research scientist who has published articles that provide counter views to the Reef science.

> But particularly for some farmers, there seems to be a bit of a tradition and culture in sugarcane that you do things because that's what your father or your grandfather did. We've somehow got to work around that and really offer them the best mix of what's on the table at any point in time and let them feel empowered that they can use that without any sort of fear or [lack of favour] from the family.
>
> (GNGO 16).

> I think there are barriers within government. My perception, particularly in terms of state government and industries like DPI, is they're all 20 years behind. To be perfectly honest, the future is going to be around sustainability and that's where they need to be putting their focus.
>
> (GNGO 15).

A Green NGO participant spoke of his view about progress and the way that GDP is measured that was different to that of Industry Group participants. One of the major reasons for the great division between Green NGO participants and Industry participants stems from their different values, knowledges and understandings about what constitutes a sustainable industry.

> So while we're just measuring GDP and things like that is a sense of progress, we end up with these problems because it's not even thinking about the stuff. Once we start measuring progress in terms of zero waste, prevention rather than cure, then we're talking - then we begin to enter the age of civilisation. I still think we're in our own dark ages at the moment.
>
> (GNGO 15).

In summary, Industry views Green NGOs as adversarial, lacking in knowledge about the industry's economic and environmental performance and driven by their ideological beliefs. Some of them did recognise the efforts made by one Green NGO (WWF) to work with the industry to trial the manufacture of innovative products from sugarcane that were sustainable for both the industry and the environment although there has been no viable outcome from this venture to date. On the other hand, Reef Protection participants (including the Green NGOs) remain concerned that growers care more about profits than the environment, refuse to listen to the scientific evidence and continue to put the health of the GBR at risk, despite the joint project between WWF and the Mossman mill.

7.5 Conclusion

The Industry Group and Reef Protection Group of participants each have their own perception of what constitutes a sustainable sugar industry, and this perception underpins the knowledge and beliefs expressed across all themes. However, it is evident from the narratives above that the dominant knowledge, most connected to power, was that of the Reef Protection participants. The scientists and experts from this group are well-connected to bureaucrats and policy makers. They already know and regularly consult each other over policy decisions and their science enjoys a privileged status. As discussed in Chapter Three, government policy is a result of the knowledge/power nexus between experts and bureaucrats. These experts had not expressed any understanding or acknowledgement that their proposed policy measure to reduce fertiliser use was perceived by the industry to have repercussions on the economic sustainability of the sugar industry. Rather, they expressed their belief that it would be a cost neutral policy measure or indeed help to create savings for growers from reduced inputs. Reef Protection Group views were based on trusted and credible expert advice they had received from Reef Protection scientists and collaborating bureaucrats. They did not conceive the possibility of a negative impact on sugar industry incomes from the implementation of the proposed policy measures. Because they believed and trusted in their own science they dismissed the Industry participants' knowledge and did not listen to them.

The two opposing groups did not share the same knowledge or values, which eventually led to a breakdown in effective communication. Each group perceived the other to be implacable, resulting in mutual distrust between them. The importance attached to participants' differing views is explored and discussed in the next chapter, within the context of the knowledge/power relations of each group and their influence on policy and governance of the GBR. Foucault's theories of knowledge/power and governmentality provide a theoretical framework for understanding the relation between scientific knowledge and the sugar industry participants in the governance of the GBR.

Chapter 8 Knowledge/Power and Governance of the Great Barrier Reef

8.1 Introduction

This chapter interrogates perspectives on environmental management espoused by the Reef Protection community. In particular, it examines how their views on environmental degradation and environmental protection have become a dominant discourse shaping policy decisions regarding the GBR. Prior to the 1980s the dominant view of farming was as an activity working in harmony *with* nature and respecting natural environmental processes. The image then was of farmers as protectors of the land (Palacios, 1998). In the 1990s this image shifted as farmers came to be depicted as 'causing' environmental damage. This new image of farmers' permeated interviews conducted for this research, and played an important role in framing how farmers manage the environment. The analysis below explores the ideas, beliefs and values that construct – and are constructed by – Industry and Reef Protection participants.

Before proceeding it is worth stressing that all knowledges presented in this study are contestable. The knowledge of the Sugar Industry Group was contested by the Reef Protection Group and vice versa. It is not my task here to evaluate the science for its validity or 'truth', but rather to undertake a discourse analysis that reveals the construction of environmental knowledges and the power relations they make visible. Foucault's theories of disciplinary power and knowledge provide a useful starting point for understanding different knowledges as well as the dominance of one in the environmental policy realm. Deconstructing the 'different' knowledges – along similar lines to the way that Haas (1992a) deconstructed the knowledges underpinning the international banning of chlorofluorocarbons (CFCs) that came about in the 1980s – provides a Foucauldian framework for understanding the knowledge regimes that govern GBR environmental policy.

The first part of this chapter explores the political and social structures that dominate the policy arena. It draws on ideas expressed in Chapter Three, which explored how the power of knowledge is derived from the use of language, norms and mores that describe and define it, along with the status and political connections of those who make knowledge claims. The last part of the chapter charts the rise to power of the environmental epistemic community and how this has enabled a system of governance over 'the environment' that could be described as ecogovernmentality. It is argued that this pursuit of ecological protection at all costs hampers desired sustainable development outcomes for both industry and environmental protection.

8.2 Reef Protection Group – an Ecological Epistemic Community

Before considering grower participants' resistance to adopting recommended fertiliser practices, it is worth identifying some of the propositions that underpin Reef Protection science. Seven propositions are discerned from the interviews conducted for this study (see Table 8.1 below). All of these propositions hinge on the validity of propositions one and two, and are used as the basis to call for immediate measures to protect an endangered GBR.

Table 8.1

Propositions Associated with Reef Protection Science.

Reef Protection Science Propositions	Number
Sediments in the run-off from farming activities are harming the coral in the GBR.	1
Nitrogenous sources of pollution are harming the coral in the GBR and the ecology of water bodies leading to it.	2
Nitrogenous pollution comes from fertilisers in agricultural run-off.	3
Because sugarcane production represents the greatest area of land use on the coastal plains adjacent to the GBR in the Wet Tropics *ipso facto* it must also be the greatest contributor of nitrogenous sources of run-off from its fertiliser usage and cultivation practices.	4
By reducing fertiliser use to the recommended levels, growers would save on production costs and thereby improve their profitability and productivity outcomes.	5
The recommended fertiliser use would not impact on growers' incomes because according to the experimental results the volumes of sugarcane would remain at similar levels. In addition, by reducing the amount of fertiliser to a recommended optimum level, the potential increase gained in the CCS levels[56] of the sugarcane would provide enough increased income to offset any potential losses from reduced volumes of sugarcane produced as a result of using less fertiliser.	6
Even if propositions one through four were insubstantial, propositions five and six were based on evidence from scientific studies that would nonetheless deliver better farm profitability.	7

[56] CCS refers to the commercial sugar content of the sugarcane. A small premium is paid to growers for increased levels of CCS in the sugarcane.

The way in which the knowledge base for these propositions developed has parallels found in Haas' (1992a) study of the events that led to the introduction of international regulations banning the use of CFCs, which were suspected of decreasing stratospheric ozone (Montreal Protocol on Substances That Deplete the Ozone Layer, 1987). Haas traces events that unfolded from the acceptance of the 1974 Rowland-Molina hypothesis that the chlorine in CFC emissions upsets the natural ozone balance by reacting with and breaking down ozone molecules. The thin layer of atmospheric ozone was deemed crucial in preventing harmful ultraviolet (UV) rays from reaching the earth's surface. Haas' study of CFC policy development sheds light on how the Reef Protection epistemic community influenced policy in Australia.

The government body known as the Great Barrier Reef Marine Protection Authority (GBRMPA) was established in 1976 and by the mid-1980s was creating a series of regulations and acts to protect the Great Barrier Reef. The Reef Protection epistemic community has continued to expand and includes scientists and bureaucrats from GBRMPA, ACTFR, AIMS, CSIRO, DEHP, JCU and other individuals from organisations nationally and internationally such as Australian Conservation Foundation (ACF) and the Australian Marine Conservation Society (AMCS). Members of the epistemic community were those responsible for identifying and calling to attention the existence of a threat to the health of the GBR and for suggesting methods to protect it. Members of the epistemic community proposed the need for stringent controls on diffuse (non-point) sources of potential water pollution, targeting farmers in particular. Similarly, the epistemic community of atmospheric scientists and policy makers were responsible for identifying CFCs as a threat to the ozone layer and in calling for international controls on the use of CFCs (Haas, 1992a).

It could be argued that Reef Protection epistemic community scientists and policy makers share a set of common values. In particular, they accept analysis that suggests sediments and nitrogenous nutrients are harming waterways and the GBR; they also advocate the need to preserve the quality of the environment by altering this scenario. The ecological epistemic community that instigated the banning of CFCs also shared a set of common values that valued the environment, and their causal beliefs lay in the acceptance of the Rowland-Molina hypothesis (Haas, 1992a), even though this view remained a hypothesis until the late 1980s. No chlorine had actually been observed in the atmosphere; the reactions between CFCs and stratospheric ozone were not clearly understood. There was not yet any indication of ozone depletion and, in fact, global ozone had actually increased during 1960s (an observation most scientists could not explain). Nevertheless, the hypothesis led many scientists and members of the public to fear that if the U.S. and other governments waited for actual measurement of

depleted ozone they would be faced with an irreversible degradation of the ozone layer. Implied was the belief that once ozone is destroyed it is lost forever and not regenerated or recreated (Haas, 1992a). Similarly, with regard to the GBR, it is implied that corals cannot cope with sediments and nutrient enrichment and as a consequence they die and then do not grow back and are then lost forever. Hence the urgent call to action to halt and reverse the loss of the coral reefs that form the GBR.

The epistemic community was transnational in both the CFC and the GBR cases. Reef scientists occur around the world and communicate regularly with each other. Some of them also work for government institutions that directly help form policy or in government agencies with direct access to bureaucrats who administer government. Like the officials in the U.S. involved in banning CFCs who had no training in atmospheric science, officials in Australia seldom had any training in coral reef health or water quality science. The atmospheric scientists in the U.S. (like the Reef Protection scientists in Australia) are in frequent formal contact, whereas the government officials interact less often. This enables scientists to further influence officials who eagerly accept their advice in line with their shared interest in conserving environmental quality (Haas, 1992a). Through the combined influences of media reports and support from the transnational Reef Protection epistemic community members, the Reef Protection epistemic community continues to raise the profile of a seriously threatened and 'dying' GBR. Transnational epistemic community members include United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Centre, International Union for the Conservation of Nature (IUCN), Worldwide Fund for Nature (WWF) and other organisations. The importance of support from these powerful organisations cannot be underestimated as their members are regarded internationally as authorities in their field and independent in their views.

The U.S. epistemic community influenced the major producer of CFCs, DuPont, to make changes to their CFC production and then push for implementation of changes in the countries in which DuPont had consolidated bureaucratic power (Haas, 1992a). Similarly, the Reef Protection epistemic community influenced fertiliser supplier companies to become involved in managing fertiliser use by obtaining fertiliser data sales to sugarcane growers.

By the mid-1980s, as a result of changes in government appointments, the anti-CFC epistemic community acquired serious bureaucratic presence, was strongly represented within the U.S. Administration and U.S. policy became more supportive of strong regulatory controls on CFCs. By 1983, the US EPA, in tandem with National Aeronautics and Space Administration (NASA) and the State Department Bureau of Oceans International and Environmental and Scientific

Affairs (OES) was largely now responsible for formulating US foreign environmental policy positions and was staffed by members of the epistemic community (Haas, 1992a). The then U.S. EPA Executive Administrator Lee Thomas, the OES Assistant Secretary of State, John Negroponte and the Deputy Assistant Secretary, Richard Benedick, and the Executive Director of United Nations Environment Programme (UNEP), Mostafa Tolba, all demanded stringent (global) action and said they should not wait until there is scientific certainty and international consensus as there was enough conclusive evidence that ozone was continuing to be depleted (Haas, 1992a).

The Reef Protection epistemic community is strongly represented in Australian government appointments to GBRMPA, AIMS, ACTFR, CSIRO and other organisations (see Table 8.2 for a sample of government appointments) and well before it became nationally and internationally known that the run-off from farms was killing coral reefs and harming waterways entering the GBR. Key figures such as Jon Brodie, previously from GBRMPA and currently with ACTFR, make repeated claims about potential environmental crisis, which precipitates urgent need for collective action. Scientists, bureaucrats and Green NGO participants in this study knew each other well and often socialised together. Participants from all three of these groups tended to come from the educated and intellectual middle class. Throughout their careers, many scientists have switched to professional positions in either a bureaucracy or sometimes a Green NGO, due to the nature of the demands for their expertise. In their familiarity with each other and well-developed relationships built on trust and professional respect, members of the Reef Protection epistemic community reinforce each other's beliefs, values and access to power. Accordingly Okasha (2002) notes that a scientist's propensity to believe a given theory is shaped by the scientist's social and cultural background and thereby technical advice reflects some prior social conditioning.

Opponents to the call to ban CFCs argued that more recent estimates of ozone depletion indicated that the scientific findings were wrong and that research was now converging on such low estimates of depletion that immediate management was not urgent. They argued that evidence was incomplete and did not dictate limiting CFC production, and suggested more research (Haas, 1992a). Similarly, in the case of the GBR, research from other scientific sources provided a range of evidence that countered the claim that sediment and nutrient run-off from farming activities was killing or harming the reef. Bartley *et al*. (2004) demonstrated that the greatest source of sediments was from high gradient slopes (almost all of which occur on land in the National Parks of the Wet Tropical Coast) and very little sediment emanates from the coastal plain where sugarcane farming occurs. Wind, current and wave data (showing that

sediments flow north-westerly alongside the coast and drop out of suspension onto the inner shelf and shore inside the GBR lagoon) demonstrate that sedimentary processes had been similar to modern levels for the past 6000 years and that corals reefs were presumably well adapted to these processes (Larcombe *et al.*, 1995; Larcombe and Woolfe, 1999; Larcombe *et al.*, 1996; Woolfe *et al.*, 1998). A review of results from 196 papers that reported nutrient enrichment as a major cause of reef decline, revealed that their actual results did not support this claim (Szmant, 2002) and that in the Elevated Nutrient Corm Reefs Experiment (ENCORE) conducted at Low Isles on the Wet Tropical Coast, where corals were dosed with nutrients daily for two years in situ, there were no clear effects on coral health even though the amount of nitrogenous based nutrient had been doubled during the second year (Szmant , 2002). The Choukroun *et al*. (2010) study undertaken between 1990 and 2008, provided results from the use of satellite tracked drifting buoy observations from the Global Drifter Program. These results enabled them to measure residence times for the offshore and on-shore regions of the GBR and calculate the daily exchange with the Pacific Ocean (flushing rate) of the GBR, which was found to be an average of 23km^3 per day. The daily flushing rate equated to the entire river discharge in one year from land at latitudes between 17 degrees and 20 degrees south, which includes all of the Wet Tropics zone plus Queensland's largest river the Burdekin. Considering that nitrogen is rapidly consumed in situ, combined with the average daily flushing rate of the GBR (possibly the fastest flushing regime reported for a reef complex) challenges the claims that nitrogenous nutrients are causing serious harm to coral health thereby making these claims highly contestable.

The anti-CFC epistemic community, through UNEP, drafted documents and reports, gathered data, organised scientific panels, pressured delegates and stressed issues that it deemed important. Executive Director of UNEP, Tolba, urged delegates at meetings to seek consensus and constantly pressed for a strong treaty. He personally chaired meetings and at one point threatened not to let delegates go to dinner until they had reached agreement. Tolba personally proposed stringent standards in excess of those proposed by most countries (Haas, 1992a). When consensus among the scientific community had been conferred by the major ozone modelers at the Würzberg meeting in 1987, UNEP's Executive Director, Tolba, argued that it was no longer possible to oppose action to regulate CFCs on the grounds of scientific dissent and that now objections based on the accuracy of the models could no longer be politically sustained (Haas, 1992a). Key scientists from the Reef Protection epistemic community (see Table 8.2 for their affiliations and areas of expertise) also produced a consenus report (Brodie *et al.*, 2008) to provide "a timely review and synthesis of knowledge and reach consensus on the current understanding of the system, as the Reef Plan approaches the halfway mark of the 10-

year plan" (Brodie *et al*., 2008:2). When a consensus forms for a particular view the debate evaporates as it is unpopular to make close examinations of fellow 'reputable' scientists' work (Boehmer-Christiansen and Kellow, 2002). Policy relevant science often isn't given a chance to develop 'naturally' towards agreement; instead policy relevance can push the science towards early closure. A consensus on the state of knowledge can be negotiated among researchers, but this is informed politics, not science. Environmental protection policy can be as much a complex reflection of available solutions and research agendas that require government support to succeed in the market place as a response to real problems. This is exacerbated when the scientists involved are either government employees or working in government funded organisations (Boehmer-Christiansen and Kellow, 2002).

Table 8.2

Authors of the Consensus Report
(Brodie et al., 2008; Brodie et al., 2009).

Contributor	Title	Organisation	Expertise
Jon Brodie (Lead author)	Principal Research Officer	Australian Centre for Tropical Freshwater Research (formerly of GBRMPA)	Water Quality
Jim Binney	Senior Consultant	Marsden Jacob Associates	Resource economics
	Funds Management Committee member	Queensland Trust For Nature	
	Board Member	Australian Government National Environment Research Program.	
		Australian Government Sustainable Planning.	
		Advisory Committee.	
		South East Queensland Integrated Science Panel.	
		Healthy Waterways Limited Scientific Expert Panel.	
Dr. Katherine Fabricius	Principal Research Scientist	Australian Institute of Marine Science	Coral Reef Ecology
Professor Iain Gordon	Theme Leader, Healthy Terrestrial Ecosystems	CSIRO Sustainable Ecosystems	Terrestrial ecology and social interactions
Professor Ove Hoegh-	Director, Centre for Marine Studies	University of Queensland	Coral reef ecology and climate

Contributor	Title	Organisation	Expertise
Guldberg			change
Dr Heather Hunter	Principal Scientist, Natural Resources Sciences	Department of Natural Resource and Water	Biogeochemistry of land and water systems
Dr Peter O'Reagain	Principal Scientist	Department of primary Industries and Fisheries	Agricultural science - grazing
Professor Richard Pearson	Director, School of Tropical Biology	James Cook University	Tropical ecology
Dr Mick Quirk	Senior Consultant	Contracted to Meat and Livestock Australia (formerly Department of Primary Industries and Tropical Savannas CRC)	Agricultural science - grazing
Dr Peter Thorburn	Principal Research Scientist, Tropical Production Systems	CSIRO Sustainable Ecosystems	Agricultural and environmental science - cropping
Jane Waterhouse	Science Coordinator, GBR projects	CSIRO (formerly GBRMPA)	Water quality science – catchment to reef
Dr Ian Webster	Research Scientist, Catchment and Aquatic Systems	CSIRO Land and Water	Catchment and marine hydrodynamics and biogeochemistry
Dr Scott Wilkinson	Research Scientist, Catchment and Aquatic Systems	CSIRO Land and Water	Catchment hydrology and material fluxes

The atmospheric scientists' influence in the banning of CFCs was applied both through the publicity of their research and through testimonies at congressional hearings and the results of new monitoring and modeling exercises that were published in the high status (and high readership) scientific journals of *Science, Nature* and *Geophysical Research Letters*. By 1985 the public was interested in the ozone issue and congressional testimonies by scientists about ozone depletion were attracting national and international media coverage. Benedick acknowledged that CFC regulation couldn't have occurred without the help of atmospheric chemistry computer models and projections that tended to be read as predictions (Haas, 1992a). Studies in the U.S during the call to ban CFCs suggested that a one percent depletion of ozone would not only adversely affect fisheries crops but would lead to between one to two percent increase in fatal and non-fatal skin cancers in human populations (Haas, 1992a). In a similar manner, public fear has been elevated with crisis-based reporting about the current and impending further loss of the coral reefs making up the GBR. Anyone 'googling' information on the health of the GBR will find lists of alarmist reports (such as reports that one third of the GBR is already dead or dying) that call for urgent action to take strong regulatory steps to protect the GBR, while predicting grim alternatives if no action is taken. For example, publications such as *Lonely Planet* guides list the GBR under the heading of 'Incredible vanishing destinations' and make statements that sediments from the rivers and rising temperatures were severely damaging the reef and that "experts warned that the reef might be almost gone by 2050" (Lynch, 2009:110).

International negotiations about CFC control measures were galvanised by the unanticipated discovery of the hole in the ozone layer over Antarctica that occurred every autumn (although its seasonality was not made clear in press reports). During 1977-85 a study reported a 40% seasonal decrease in the Antarctic ozone layer and concluded "possible chemical causes must be considered". The reported ozone hole combined with increased use of CFCs alarmed the public and added urgency to regulatory measures (Haas, 1992a). Similarly, fears of global warming and climate change give cause for further alarm over the imminent death of the coral reefs, particularly when combined with the dangers being reported from sediment and nutrient run-off.

Atmospheric modelers developed increasingly sophisticated models about harmful effects of CFCs over the decade, offering clearer predictions and scenarios with greater certainty, while in reality, modelers were *creating* the world that they were simulating for decision makers and no-one else had any understanding of the physical area being studied (Haas, 1992a). People relate to models as if they are correct and factual, when they are a simplified representation of reality used to facilitate the making of predictions, and are a best guess based on the extrapolations of

the data. Direct measurement of outcomes under controlled conditions will always be more accurate than modeled estimates of outcomes. When predicting outcomes, models use assumptions, while measurements do not. As the number of assumptions in a model increases, the accuracy and relevance of the model diminishes. George Box, Professor Emeritus of Statistics at the University of Wisconsin in 1992, was quoted as stating that "essentially all models are wrong, but some models are useful" (Box and Draper, 1987). As someone who used models prolifically in his work, his intention was not to discredit modeling *per se*, but rather to remind us not to relate to models as factual. Kellow (2007) and Crichton (2005) argue that complex computer models equate to virtual science and that much of the contemporary environmental science published in leading journals is not conducted with the same kind of safeguards found with medical research. The scientific reports and papers produced by the Reef Protection epistemic community are peppered with models that simplify ecosystems and amplify potential anthropomorphic effects on the health of these ecosystems. The discourse of environmental science confirms its dominance in society through the aid of measuring, monitoring and assessing farming practices and using a language of 'rationality' and 'truth' embodied in the graphs, tables, statistics and models they devise to 'verify' and lend authority to their knowledge, scientists have become more and more powerful. These models create visual representations that influence readers more strongly than spoken or written words (Padian, 1987) and lend weight to their argument.

US EPA-sponsored computer modeling based on projected demands for CFCs estimated that a 5-11% annual growth of CFC emissions would yield 40 million cases of skin cancer (800,000 of them fatal) in the US over the next 88 years, above the number that would occur if CFC emissions were held at constant 1986 levels. Models also projected that simply stabilising the current CFC concentration in the stratosphere would require an immediate 85% cut in emissions. The EPA-UNEP atmospheric ozone study served as the scientific basis for the ensuing international negotiations and the OES and EPA reps wrote the US position paper on CFCs. Here the epistemic community influence was crucial. It was the anti-CFC epistemic community who was responsible for determining the range of chemicals (within CFCs) that were covered, then stringency of controls and the time frame for implementing reductions, then it was the US EPA officials who were members of the epistemic community who wrote the regulations (Haas, 1992a). Likewise, Reef Plan regulations were developed by the Reef Protection epistemic community members.

The costs of banning CFCs in the US alone were estimated to be in the hundreds of billions of dollars, let alone the costs to other developed and developing nations (Haas, 1992a). Costs involved to protect the GBR from sediment and nutrient run-off have been estimated at $50 million for new legislation, $200 million for the Reef Rescue Plan, plus $125 million on additional measures for enacting the legislation (Queensland Government, 2010). The Reef Plan was enacted due to the influence of the Reef Protection epistemic community, yet Propositions 1 and 2 (see Table 8.1), upon which their case rested, were considered by members of the Sugar Industry group to be incorrect, unsubstantiated and highly contestable. The deconstruction provided above, paralleling Haas' study (1992a), provides enough evidence to confer that Propositions 1 and 2 were indeed highly contestable.

If the Reef Protection epistemic community had not led the identification of threats to the GBR, concern for reef protection and the pressure for strong measures of control then other knowledges challenging the urgency for control of farmers' fertiliser use might have received more public credence. The Reef Protection epistemic community was considered as the only competent scientific group that could interpret the information underpinning policy. This epistemic community contributed to persuasion of individuals and groups and decision makers in government. In so doing they limited the range of alternatives that decision makers considered.

8.3 Grower knowledges

Grower knowledges are derived from their forebears and from decisions based on their own knowledge and experience and that of their peers. Their views on farming are shaped by a lifetime of daily observations and tested cultivation practices. As a consequence grower participants are confident they understand and know their land and their crop's requirements well. But growers' knowledge and expertise are not always recognised by the scientific elite because they are not formally documented and standardised – or in Foucault's terms 'disciplined' – in ways recognisable to those who adhere to the scientific mores and norms. In Allan's (2005) study of farmers, she found that scientists considered a farmer's tacit knowledge to be rarely valid or real, and often as wrong or unscientific. Similar to findings in Allan's study, the Industry Group in this study spoke of agronomic practices used by growers as demonstrating a well-developed knowledge-base of the industry, although it was not recognised or authenticated as such by many non-industry scientists.

The Reef Protection Group often considered the growers to be uneducated and 'unscientific' in their approach to land management. Grower participants' intellectual frameworks, cultural outlook and way of life were not compatible with the scientific-bureaucratic cultural idiom. Due to its unscientific nature, growers' knowledge was underrated and often ignored. Their knowledge was not articulated or presented in a way that could compete with the 'science'. The rhetorical power of science forms part of the ground rules of power. Ordinary common sense appears less articulate and persuasive compared to the explicative power of scientific language (McKechnie, 1996). The power of scientific knowledge over and above other forms of knowledge has become the norm in modern societies (Beck, 1992a, 1992b).

Philosophers of science and sociologists of knowledge argue that knowledge must be placed within an interpretative context for it to have meaning (Kuhn, 1962; Latour, 1987; Polyani, 1962). This socially mediated character of knowledge becomes recognisable when we are confronted with a 'fact'. Upon being presented with a knowledge claim or fact we quickly seek to link it to a particular social network. Who delivered it and where it came from are very important factors (Carolan, 2006c). Expertise and its credibility are contingent on trust and authority within social relationships (Carolan, 2006a, 2006b, 2006c, 2006d; Carolan and Bell, 2003; Kuhn, 1962). It was evident in this study that visiting experts are credited with greater authority and respect when their knowledge is consistent with the local values they are appealing to. Grower participants were not ignorant, but rather when they assessed the array and sources of knowledge claims presented to them, they judged them accordingly and then selected the knowledge that best fit with their personal sense of trustworthiness and their own construction of reality.

In her study of farmer adoption, Allan (2005) notes that conflicts arise when outsider experts, in their attempts to convince farmers to adopt practices, are ignorant of the needs of farmers and do not relate to growers' values. The Reef Protection participants prescribing the adoption of the modified fertiliser practices had expected a positive reception and acceptance of their knowledge and advice to growers. Just as Reef Protection scientists were surprised when growers were resistant to their scientific advice, growers were frustrated with scientists who dismissed their concerns about the effects of reduced fertiliser use on their crop yield. These scientists viewed growers' concerns as invalid and foolish. Growers perceived these scientists as unyielding, stubborn, arrogant and incorrect. The bottom line for the growers and everyone who worked in the sugar industry was made up of two critical economic realities: (1) the payment system is based on the volume of sugarcane that is produced, harvested, milled and processed throughout each step of the value chain in the industry; and (2) any payments made

for high CCS levels were eclipsed by payments earned through crop volume and the compelling need to maintain high volumes of production in order to keep the mills viable and the industry economically sustainable. In this respect the Sugar Industry group participants considered Propositions 5 and 6 (see Table 8.1) to be absolutely incorrect in their experience, which provides some explanation for the non-adoption of the Reef Protection recommendations to restrict fertiliser application rates.

The way the scientists used technical language and assumed authority over the growers at workshops and conferences did not endear them to the grower participants. In contrast, growers were far less interested in knowledge they believed had not been fully tested under all potential conditions over a period of time. Growers' understandings include but are not limited to the scientific norms and mores, and are instead based on a wider range of evidence. Grower participants did not welcome what they considered to be esoteric knowledge or those who used it to assert authority over them. Scientists who had attempted to impose their knowledge and values (doctrines) upon them had lost their reputation with growers rather than the reverse. The superiority of scientists' abstract knowledge was undermined compared with knowledge they gained from experience. In general, grower participants did not relate as well to experts who lacked first-hand experience in sugarcane cultivation or who spoke to them personally or in public meetings in predominantly scientific language. Growers discussed instances where scientists were occasionally condescending and would communicate in a highly technical language about details regarding their own farms and in a manner that indicated they thought the growers did not understand these concepts. What annoyed growers most was when they considered the experts were mistaken or got something wrong, yet they had not asked growers about their knowledge and experience of that phenomenon. Growers did not appreciate being treated as ignorant, especially when it came to questioning aspects of their farming practices from which they earned their own livelihoods.

8.4 Deconstructing ways that power/knowledge is expressed

Methods of disseminating scientific knowledge – such as scientific journals, government reports, conferences and news media – elevate and empower scientific knowledge and lend it the appearance of impartiality and objectivity. Industry participants, however, tend to shy away from general news media. Grower participants, like many farmers, usually work in the social and geographical isolation of small townships, which encourages them to be independent, private, self-contained individuals (Allan, 2005). When growers had grievances they tended to look to industry associations (such as Canegrowers Organisation) to represent and defend them.

These industry associations did not experience the same reputation, respect or sympathy in the press as Reef Protection participants enjoyed. Studies such as Wildavsky's (1995) have noted that in cases of environmental issues journalist bias against industry is common. Similarly, Sugar Industry participants are more often cast by media journalists as being partial, biased and less trustworthy. Indeed, the Industry participants' knowledge carried less authority in the media than that of the Reef Protection Group.

In contrast to the dominant scientific knowledge, the industry knowledge was mostly 'local knowledge' (LK) or 'rural people's knowledge' (RPK)[57] that had been gained from their experiences and augmented by scientific knowledge from research devised to increase productivity. This knowledge presided with people in industry rather than in scientific journals, and was not sensational or newsworthy. The knowledge that did gain media attention was of a type that could be readily produced and provided in a form that media prefers, that is, consistent with controversial predictions and warnings that tap into society's fears.

As mentioned earlier, pictorial representations of current and future scenarios are highly influential tools for convincing others of the reality and 'truth' of their propositions. According to Padian (1987), who studied the power and influence of scientific propositions in movies, pictorial representation is a powerful determinant of perception that doesn't need to be accurate, but only plausible, to make a strong and lasting impression. Padian (1987) said that however inaccurate a picture, it can be worth a wealth of documented evidence to the contrary. Doomsday type scenes in the movie *The Day After Tomorrow* (released in 2004) provided powerful images of a global havoc in a world where the gulf-stream (northern hemisphere) failed due to human induced global warming. Even though presented as cinematic fiction, because of the use of science in the film, the public related to it as if it were true, or at least plausible. Al Gore was able to use the public response to this film as a platform from which to launch his own film *An Inconvenient Truth* (released in 2006). The combination of Al Gore as a charismatic speaker, the use of validating scientific graphs, tables and models combined with powerful images of predicted horrors and damaged environments, provided a winning and convincing formula for concern and fear to fuel a call to action.

Images on television of flood plumes from rivers carrying sediments out to sea provide highly influential and convincing evidence of pollution. Yet these images, televised throughout Australia and overseas, would not shock people who have grown up in a tropical environment.

[57] Rural people's knowledge (RPK) was coined by Thompson and Scoones (1994) and has slowly been gaining legitimacy with extensionists and some scientists.

Tropical environments experience very heavy rainfall during the wet season and it is not unusual to experience very muddy waters flowing out to sea during the season's first flush. Conversely, images of this event, viewed in isolation by people living in cities in the temperate southern latitudes, cause alarm and concern. Even though Bartley *et al.*'s study (2004) concluded that the bulk of the source of mud from a high rainfall event came from the steep slopes and mountains in the National Parks, and Larcombe *et al.*'s study (1995) provided evidence that plumes of muddy water drop out onto the inner-shelf within a day or two due to the action of the prevailing south-easterly winds and currents, these findings did not gain media attention. Consequently, the powerful images that 'speak for themselves' are treated as evidence and 'proof' which is very difficult for growers to refute through the existing apparatuses and methodology and in a language that others can hear and believe.

The media plays a powerful role in constructing and supporting dominant views. Wildavsky (1995) reported on findings from a survey carried out by American Opinion Research Incorporated and conducted in 1993 about the views and biases of 512 journalists who worked in news media. The results showed patterns of where environmental reporters sourced story ideas, information and data. Half of the journalists relied mostly on government officials, press releases or reports and a third relied on environmental and consumer groups. One in six reporters relied on academics, universities and professional journals for ideas. Of those sources with predictable biases – environmentalists and consumers on the one hand and business and industry on the other – the journalists relied on the former for information eight times more often than they sought information from the later source. Although a similar study has not been conducted into journalist biases against the sugar industry and in support of Reef Protection views, Industry participants claimed that there was a media bias supporting the environmentalists' views over theirs.

Authors such as Fairhead and Leach (2000, 2003b) and Leach *et al.* (2007) have shown a view of scientists as constituted by dominant discourses and having preconceived perceptions based on previous studies and experiences in other parts of the world that they then bring to consecutive case studies in alternate locations. Reef Protection scientists from GBRMPA, AIMS and ACTFR referred to their experiences of reef degradation in other parts of the world and their fears that the same outcomes would eventuate in the GBR. The standard methodology used for conducting scientific fieldwork constrained scientists in how they collected their data (such as the time of year, length of visit, sample size, location and ease of access); how they

made their observations; and how they interpreted the data. Fly-in-fly-out (FIFO) scientists[58], much like the ones described in Fairhead and Leach's studies (2000, 2003a, 2003b), arrive already immersed in their discourse before they examine the GBR. They reinforce their view of the GBR with images of environmental damage derived from prior scientific analyses and media images that have been incorporated into the discourse of scientific institutions and the popular consciousness of state functionaries. The images are regularly reproduced in the media, schools, national university curricula and academic theses. As a result, causal readings of the landscape and events like plumes and run-off during the wet season come to serve as further confirmatory evidence for preconceived views about reef degradation and its causes. This view has been extrapolated into a paradigm that the use of fertilisers will *always* pollute waterways and harm reefs based on other global examples.

The ways in which the two main sets of knowledge were transmitted in this study were a function of the power attached to each kind of knowledge. Figure 4 provides a diagrammatic summary of the contributing factors for each kind of knowledge.

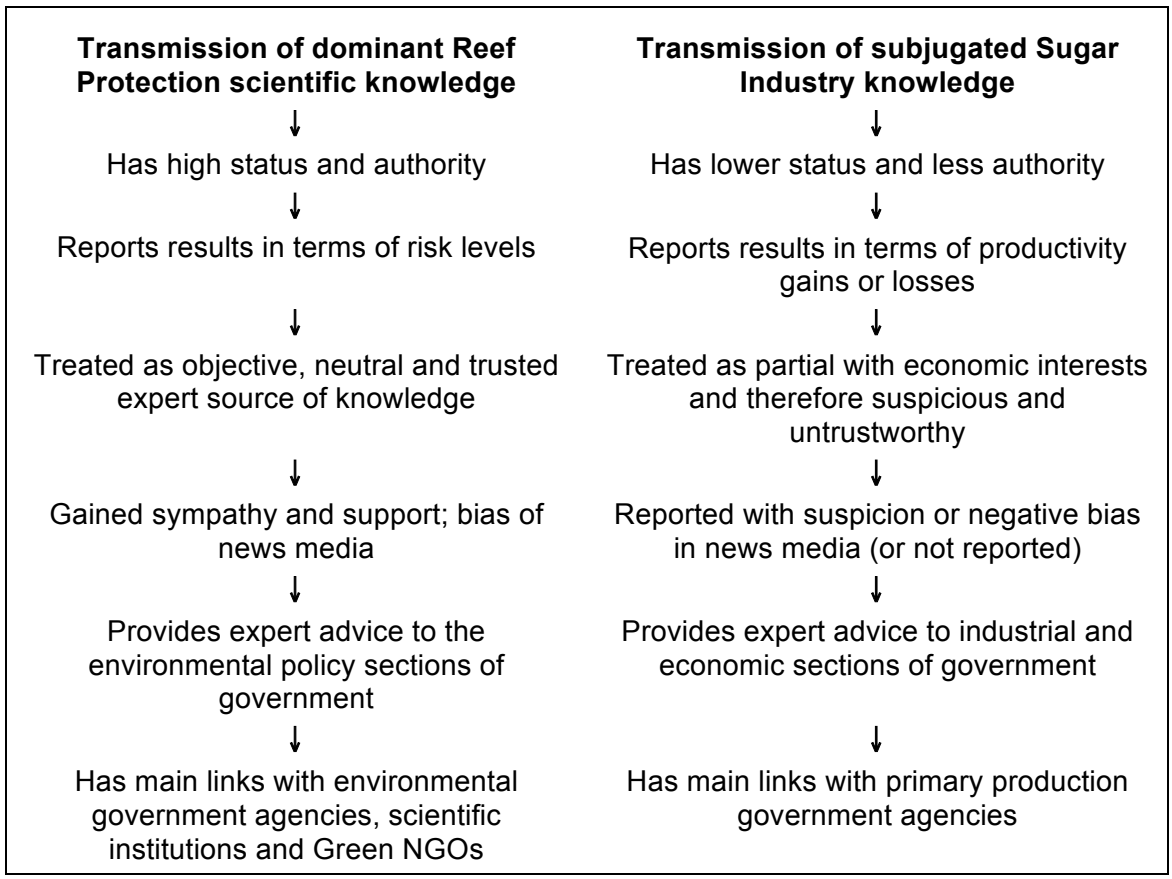

Figure 8.1 Summary of the Ways that Reef Protection Knowledge and Grower Knowledge were Transmitted and Received.

[58] FIFO scientists is my own term used to describe scientists who take a brief visit to a site (usually a few days, but can be as little as one day) to make a first-hand assessment and then conduct the rest of their study at their desks, using other collaborative scientific sources.

Kuhn (1992) described the concept of a scientific paradigm in a similar manner to the way Foucault might describe a dominant scientific discourse. Kuhn's concept of a scientific paradigm involve agreement from scientists on: particular supporting scientific propositions; the ways in which future scientific research in their field should be conducted; which problems should be examined; the appropriate methodology to use; and what would constitute an acceptable solution of the problem. Like a discourse, a paradigm was a set of shared assumptions, beliefs, and values that united a community of scientists and facilitated the discipline and practice of 'normal' science. Kuhn asserted that scientists operated within the paradigm and as a result did not *test* the paradigm itself. They accepted the paradigm wholeheartedly and without question and they conducted their scientific activities within the boundary of the paradigm. The dominant power of the paradigm or discourse is so strong that when scientists produced results that conflicted with the paradigm they would dismiss them as errors, rather than question the paradigm. The paradigm itself was not open to negotiation (Okasha, 2002).

During professional and personal communications Reef Protection epistemic community members made disparaging comments about authors who challenged the consensus and questioned not just their scientific methods and results but also cast aspersions on their character, motives, professional ability and associations. The practice of excoriating the counter-consensus scientists is a common method employed by consensus scientists seeking to maintain their ascendency (Kellow, 2007). Many of the Reef Protection epistemic community members had not read scientific journal articles written by non-consensus scientists, but had nonetheless formed views based on their peers' commentary. The dominant discourse maintained what the 'truth' was, and who the reliable and untrustworthy sources of knowledge were.

In addition, expert knowledge that informs policy cannot be separated from the financial context in which the scientific institutions operate and the *raison d'être* of these institutions is the business of environmental risk management and environmental rehabilitation (Fairhead and Leach, 2000). Funding for scientific research in the Wet Tropics is tied to studying, protecting and ameliorating the environmental degradation of Australia's 'crown jewels of biodiversity'. It is also linked to the demand for and regional income from ecotourism. At local and national, as well as international levels, the economic structures within which scientific institutions and environmental agencies operate frame the ways that information is derived and applied.

The increasing influence of specialised groups such as epistemic communities can affect the way that democracy is delivered. Small groups of scientists, forming epistemic communities that exert power and influence over national and international laws to manage the environment (Haas, 1992a) do not necessarily represent the majority of the electorate. Elected politicians are paid to represent the electorate and are held responsible for mistakes made or decisions that failed, not the scientists.

The Reef Protection epistemic community forms a crucial part of the governance that directs bureaucrats, politicians and policy outcomes on how activities are perceived and managed that are considered to harm the GBR. This rise to power of environmental epistemic communities has progressed governmentality into a system of governance over 'the environment' known as ecogovernmentality.

8.5 Ecogovernmentality

Foucault (1991a, 1991c) argues that governments have been invested with increasing authority to manage nature. To understand how the dominant view of sustainability shifted towards a more ecologically-centric focus (away from a strongly economic focus) we need to understand the governance processes involved. Governance is distinct from government or the state. Government is concerned with the power of sovereign states to make policy and to influence other actors such as firms and members of the public. State authority is commonly seen as derived from the rule of law and, ultimately, from material (and military) resources. Governance is what government does; it is the process of decision-making and the process by which decisions are implemented.

The processes of decision-making (politics) and processes of implementation (bureaucracy) comprise the classic Weberian division between elements of state organisation. As described in Chapter Three, Weber's (1978) theory of bureaucracy points to ways that the ecologisation of Western style governance has come about. The power of an epistemic community cannot be underestimated as it is the authoritative source of specific information and it directly influences both the politics and the bureaucracy of an issue. Over the last few decades, since a risk-oriented and risk-averse society emerged, there has been a shift from state-led government and planning to a reliance on epistemic communities for guidance on how to manage various environmental issues (Beck 1992a, 1992b; Haas 1992, 1992a, 1992b; Luke, 1996, 1999). Even with the strongest state leadership planned outcomes are often subverted by the realities of bureaucratic politics (Haas, 1992a).

As discussed in Chapter Three, Luke, Darier and Rutherford derive the concept of ecogovernmentality as an extension of Foucault's concepts of biopower and governmentality – two terms used to analyse the regulation of the social interactions with the natural world (Agrawal, 2005; Darier, 1995; Luke, 1995a, 1996, 1999; Rutherford, 1999). Ecogovernmentality focuses on how government agencies, in combination with reliance on epistemic communities, construct 'the environment'. Along with the construction of the environment has come an acceptance that the environment needs to be 'managed'. This ethos has become a natural progression of the increasing state control over its population and increased intervention in the nation's economic wellbeing since the end of the Enlightenment period (Sairinen, 2000). Over time, the state's role has come to include protection of the environment as an extension of its shepherding role.

Growing interest in, and concern for, the environment has been concurrent with the development of a 'risk society' (Beck, 1992a). This phenomenon can be linked to the increasing wealth and social security and expansion of the intellectual and middle classes in post-war western nations. Compared to other nations, the vast majority of Australians enjoy a comfortable middle class lifestyle, with its associated security of employment, health, education, social welfare and opportunity for economic advancement. As so many of our more immediate needs have been met and our standard of living has increased Australians' tolerance of risk has diminished and as a consequence our everyday activities have become more and more regulated for our own protection. In agreement with views from Fairhead and Leach (2003b), Goldman (2001) and Luke (1995b, 1999), the better we have become at managing the risks to our wellbeing, the more we have expanded our arena of management into the natural world. As the nation's attention shifted away from the need to advance, promote and safeguard our agricultural industries towards growing concerns about the environmental risks of agricultural activities in an era of increasing ecological alarmism, the call for state protection of the environment has become more paramount.

The GBR is an international icon of great value, importance and emotional attachment for Australians. Australians share a sense of nationalistic pride for this natural icon and any apparent threat creates cause for alarm. Approximately 89 percent of Australians live in cities (United Nations, 2010) and there is an increasing division between rural and urban Australians (Bowler *et al*., 2002). In their comfortable urban middle class lifestyle where city dwellers enjoy excellent access to all amenities, empathy and understanding for the predicament of farmers has naturally waned. Since quite recent times (approximately since the 1980s) very few urban Australians know any farmers or have ever met a farmer and urban Australians' views

about farmers tend to be shaped by the media (or lack thereof). Consequently, even fewer Australians would know of or really care about the issues faced by sugarcane growers, especially when compared to those who would care more about the health of the iconic GBR. If the people in Australia's capital cities (Sydney, Melbourne, Brisbane, Adelaide, Perth, Canberra and Darwin) who make up the bulk of voters were alarmed into fearing the loss of such an important icon, then politicians would be forced to respond accordingly. Australia has the good fortune to be currently experiencing a relatively healthy economy. Comfortable economic conditions enjoyed by the majority of the population allow for environmental concerns to rate a higher level of importance with the electorate. At the same time, since the 1970s, Australia has experienced a surge in economic activity that is now derived from the business of ecological protection. The epistemic communities involved in the pursuit of increased ecological protection have gained power during this process and this has helped to pave the way for a rise in ecogovernmentality.

Studies about epistemic communities show how they always press for regulatory methods and greater state control to manage an environmental issue (Goldman, 2001; Haas, 1992a; 1992b). Because growers did not welcome the proposed changes to the reduction of fertiliser application rates voluntarily, the Reef Protection Group lobbied for legislative measures. Legislation validates and seals a policy decision. Compared to an EMT perspective, this is not the best way to develop environmental policy. It is adversarial, costly to develop and even more costly to administer and enforce, too rigid, quickly outmoded, punishes everybody in the process and always falls to the lowest common denominator in terms of a standard. Laws discourage industrial innovation and are so difficult to change that they linger on long after they have demonstrated their disutility (Goldman, 2001; Jasanoff, 1990, 1996; Jasanoff and Wynne, 1997; Wynne, 1992a, 1992b).

Epistemic communities can hinder democratic processes because the elite few make decisions for the rest of society, who must also bear the cost. Scientists in an epistemic community can take an adversarial approach towards industry, opting for regulations to make industry comply, without engaging in a way forward that benefits industry and society as a whole. They are not required to take political, social or economic responsibility for their role in the policy process. Scientists in an epistemic community are not answerable to mistakes and failures in the way that a politician is. Politicians need to become more aware of the politics of this process of governance and of the inherent problems that arise from relying on legislation to fix an environmental problem. Politicians would benefit from becoming more familiar with an EMT

approach used by the top six performing nations in environmental policy performance (see Chapter Three) when dealing with environmental issues.

8.6 Conclusion

Foucauldian perspectives provide a window into the complexities of the environmental knowledge/power nexus and the way that we construct both truth and trust. The Reef Protection scientists and policy makers who were advocating the change in fertiliser use were part of the epistemic community that represented the dominant knowledge with access to power that most strongly influenced policy. When Reef Protection Group scientists were not able to convince growers through their evidence and logic to conform to their advice they labeled them as stubborn and ignorant and then resorted to regulatory policy.

The Reef Protection participants who pressed for reduced fertiliser use believed that this innovation was both economically and ecologically sound and were confident of their knowledge. They could not conceive that their science was contestable or that there might be a valid reason for growers' rejection of their evidence or recommendations. This chapter presents an analysis that makes Propositions 1 and 2 (Table 8.1) highly contestable and Propositions 5 and 6 to be deemed incorrect by members of the Sugar Industry group. The analysis suggests an explanation for the non-adoption of the recommended changes to fertiliser practices and the reasons why the epistemic community's members resorted to regulatory measures.

The Industry participants considered themselves marginalised and falsely accused of wrongdoing. They contested the Reef Protection science and felt unheard regarding their perceived threat of the recommended practice to their livelihoods and they remarked on the lack of respect for their knowledge and experience. Like studies conducted by Allan (2005), Glyde and Vanclay (1996), Jasanoff and Wynne (1997), Wildavsky (1995, 2000) and Wynne (1992a, 1994), this study is yet another example of the similar ways that environmental problems have been described and managed in ways that often result in damaging effects and outcomes for farmers. This is not to support the claim that particular scientists or institutions are consciously pursuing attempts to use information for political or economic ends. Rather, epistemic communities are also constituted by discourses and reproduce those discourses.

Put simply, two competing discourses emerged: (1) Environmental degradation and protection; and (2) Sustainable farming. The Farming discourse is a world-view that values shared farmer knowledge and their ways of managing their land and reasons for adopting some practices over

others based on decades of experimentation. In contrast, the discourse of Environmental degradation and protection is usually espoused by academic and research scientists, and government bureaucrats. This discourse is a world-view that privileges science and deductive forms of reasoning, and is instrumental in intent (for developing policies and regulations). Both of these discourses overlap in terms of ideas about practices of Environmental Management, however the opportunity for each group to *equally share* their information for more sustainable outcomes was not realised here.

Chapter 9 Conclusion

9.1 Introduction

This research is an in-depth examination of sugarcane growers' resistance to the adoption of recommended reduced rates of fertiliser use in the Wet Tropics. It is also a study of the discourses of reef protection science and policy, which it is hoped will be useful for improving the development of environmental policy. The evolution of the knowledge/power nexus of environmental policy is also explored to understand how it has led to a form of governance known as ecogovernmentality.

Eighty-two participants took part in this study comprising a total of forty-nine growers from the Wet Tropics sugar mill townships of Mossman and Tully (and included three 'pilot' growers) and thirty-three participants who worked in the sugar industry or in jobs that had an interest in the environmental performance of the sugar industry and protection of the GBR. The research began with an extensive literature review to contextualise the sugar industry and to situate growers within the discourse of the environmental problem and its management. An EMT conceptual framework was used to analyse and interpret the efficacy of the recommended environmental practice, or innovation, and the policy development process used to manage the environmental problem. A Foucauldian theoretical framework was also used to explore the ways in which growers and farming, and reef protection policy scientists and science, were constructed within the discourses identified in this study. The theoretical frameworks that were employed and the way that they were used to analyse and interpret the participant's discourses had not been applied to a single agricultural industry in this manner before.

The research set out to examine barriers to the adoption of recommended fertiliser practices by sugarcane growers in the Wet Tropics. The question that drove this research study was:

- *What were the underlying barriers to adoption of recommended fertiliser practices by sugarcane growers in the Wet Tropics?*

In order to answer this question the following questions were addressed:

- *Were the growers who did not adopt the recommended practices being recalcitrant and ignorant?*

- *Were growers at liberty to make unencumbered decisions about their cultivation practices?*

- *Were there legitimate reasons why growers did not adopt certain practices?*

- *Did the mills play an important role in influencing growers' cultivation practices?*

This study has focused on the important relationship between the sugar industry and those involved in developing environmental policy affecting this industry. Through the course of the study it became apparent that images of sugarcane growers and reef protection scientists and bureaucrats did not fit with the everyday accepted discourses of growers, science and scientists in the arena of environmental policy development. The following discussion presents conclusions from the research and suggests implications for the way that environmental policy might be developed in the future.

9.2 Discussion

An extensive review of the literature is found in Chapter Two. The review discloses how and why the sugar industry developed in the Far Northern region of Queensland, the regulatory system that expanded with its evolving structure and culture and the era of modernisation through mechanisation that shaped the industry into a once world leader. The literature review also records a change in the framing of the industry during the 1980s when farming turned from a 'good' and noble vocation with farmers working in harmony with the environment as protectors of the land, to an activity that needed to be carefully monitored and managed in order to protect the environment from farmers' practices.

Through an EMT analysis of the findings the problems of the recommended environmental practice, or innovation, became evident. As discussed in Chapter Three, an EMT framework has industry as its central focus of working towards the enhancement of the ecological modernisation of industry. Ideally an innovation is designed to suit the industrial needs and economic imperatives of the industry while delivering improved ecological outcomes in a progressive fashion that facilitates the evolution of an eco-industrial society. EMT veers away from the *disciplinary* punishment through legislative methods, designed to *enforce* change at the cost of potentially extinguishing the industry (and possibly exporting the industrial process and

problems to developing nations). Rather it encourages a collaborative and supportive approach and hence the win-win philosophy of EMT. In this study, industry participants perceived their needs were neither heard nor met, the state was unable (and unwilling) to provide economic incentives to foster the uptake of the innovation, the innovation was built on contestable science, and the Green NGOs were adversarial rather than collaborative.

The EMT analysis examined reasoning behind barriers to adoption of the recommended practice through an industry-centric focus. This is not the usual way of studying farmers' resistance to adoption however. The more usual way is to use Rogers' (1962, 1995) theories and study the barriers to adoption through a grower-centric focus. The EMT analysis thus provided a different perspective that led to a critique of the innovation itself and its efficacy as a policy measure, rather than the usual litany of reasons why growers adopt or do not adopt a recommended practice. In this sense the EMT analysis is very useful in pointing to the weakness of the innovation and the policy method of enforcing the practice through legislative measures. This type of analysis offers policy developers and proponents of innovations an alternative view of how they might reflect on the way that they go about devising innovations and policy.

The results of this research showed that the participants were positioned within discourses of the Sugar Industry Group or the Reef Protection Group. The main themes of the interviews were discourses of: Sustainability; Growers and Farming Practices; Science, Technology and Expert Advice; Government; Regulations; Mills; Green NGOs; and Grower Adoption. These themes were used to structure the discussion.

The Foucauldian analysis in this study shows that the participants were generally positioned within their disciplines (of environmental science and farming) and the practices of power within them. This was not so in all cases, due to the nature of some of the participants' jobs and their resultant disciplinary norms, but for the majority of participants their views were homogeneous. The grower participants were disciplined by the norms of farming – creating food and income for the country, being productive and making a profit and being keepers and protectors of the land. Reef Protection scientist participants were disciplined by the norms and mores of science.

The Foucauldian analysis of the discourses surrounding the practices of farming and environmental science provided an additional theoretical and analytical tool for delving more deeply into the themes and issues. This additional form of analysis arose as part of an inductive process and provided a more nuanced understanding of the way that participants constructed the

environmental problem. It also shed light on the knowledges of each group of participants, the power relations of those sets of knowledges and the evolution of the policy development process regarding the definition and management of environmental issues. This type of analysis offers policy developers and proponents of innovations an alternative view of how they might devise innovations and policy to preserve the economic sustainability of industry. At the same time, the analysis is confronting for the proponent scientists and the policy makers.

Some of the revelations about growers from the discourse analysis were not unexpected. The research confirmed that growers were driven by economic imperatives and farming was foremost a vocation and livelihood. Yet, growers still position themselves as custodians of the land and understand the need for farming within the confines of looking after the environment, which, they also considered would *ipso facto* look after them. To growers this knowledge and understanding about farming was an obvious element of being a successful farmer. They did not stress the importance of the environment *per se* but rather saw it in the light of a more tacitly and implicitly interconnected part of their understanding of farming practices.

The analysis also showed growers' dualistic views about science, technology and expert advice. On one hand, they appreciate and even heavily depend on the continual improvements in productivity that science and technology can deliver. These sorts of improvements have kept the Australian sugar industry at the forefront of efficiency and enabled them to continue to compete effectively on the world market. Growers were well aware of the R&D technologies that could continue to give them the market edge in the future (such as through bio-technological advancements) and welcomed these innovations with enthusiastic anticipation. Conversely, growers were frustrated with some of the 'other' science and expert advice that focused on the environment more than on growers' productivity outcomes. This was not the case for each recommended environmentally focused innovation. Where the innovations enhanced productivity as well as environmental outcomes (such as GCTB) they were quick to accept and enthusiastically adopt these practices. As evident in this study, the recommended fertiliser use practice was perceived as not necessary for protecting the environment, did not provide favourable productivity outcomes and in fact, threatened their current and potential productivity and income.

Growers were not averse to the adoption of most of the practices that had been put to them. They said that they were just averse to adopting practices that they *knew* would not work or had been seen to fail, or to practices that were unnecessary and counter-productive. The analysis also revealed that growers felt marginalised by scientists. Growers were not consulted about the

recommended practice and when they tried to communicate their knowledge and understanding they felt ignored. When growers tried to be heard through industry associations they claimed their experience and knowledge, and the science that ran counter to the consensus were all summarily dismissed. The Sugar Industry participants' believe government no longer supported them, but rather now deferred to the 'green lobby'. Government capitulation to legislative measures that would enforce changes to fertiliser pratices upon the growers was given as evidence to this belief. Sugar Industry Group participants generally felt abandoned by government and isolated from public support. Scientists, bureaucrats and Green NGOs were perceived as having more access to government support than them. The Sugar Industry Group participants felt powerless against the Reef Protection Group's scientific models, language and support from international organisations and were convinced their words fell on deaf ears. The power/knowledge relations that existed in the epistemic community of reef protection science were too strong to be resisted in a way that would effect change to the dominant discourse.

The revelations about Reef Protection Group scientists and science from the discourse analysis presented were more unexpected. The analysis raised doubts about the propositions that the science supporting the recommended practice was based on, and in particular about the methodology used to enforce this practice through legislative policy measures. Reef Protection Group participants' primary concerns were for the protection of the GBR and as such they were focused on the environmental performance of the sugar industry as part of their quest. They were so confident of the scientific evidence used to warrant intervention into the sugar industry's cultivation practices that they were prepared to advise government bureaucrats to use legislative policy measures to enforce this practice, despite the sugar industry's appeal not to take this course of action. The advice of the Reef Protection epistemic community, revered by bureaucrats who share the same values, strongly influences policy making decisions.

The analysis revealed Reef Protection Group participants' views of growers as environmental vandals (despite evidence to the contrary regarding adoption of recommended practices such as GCTB). They depicted growers as "stubborn, ignorant, recalcitrant and foolish" not to realise the economic benefits from adopting the recommended practice. Many of the Reef Protection Group participants believed that the sugar industry was expendable when compared to their perceptions of the value of the GBR and the ecotourism industries that depended on the preservation of its pristine quality. Moreover, the Reef Protection Group participants were convinced of the need for legislation because the growers were perceived to be more interested in profits than in the health of the GBR. They suggested that growers were unconcerned about

how their cultivation practices might affect the GBR, which they believed growers must *know* was being compromised by the growing of sugarcane.

Many Reef Protection Group scientist participants were unaware of the failure and inappropriateness of numerous previously recommended practices pushed upon growers in the Wet Tropics. Double row panting and soybean fallow crops are two examples. But more importantly, most of the members of the Reef Protection epistemic community were ignorant of the cane payment system. The cane payment system is completely dependent on the volume of sugarcane produced for every activity in the value chain process to produce sugar crystals. All industry members and sectors including growers, harvesters, millers, R&D institutions and industry association staff, are paid according to the volume of sugarcane produced. Any threat to the volume of sugarcane produced is a clear threat to the payment system and the income of all those involved in the industry. The use of fertiliser is the most effective and important tool for producing increased volumes of sugarcane. Reef Protection epistemic community members were ignorant of the fact that any gains in income made through increasing the commercial content of the sugar in the plant were eclipsed by the greater amount of income gained by increasing the volume of sugarcane produced. The fact that each sector of the industry is dependent on and paid according to the volume of sugarcane (plant) produced also makes growers (who share a co-dependency with each of the other sectors in the value chain) to support their industry colleagues economically and socially (as they also socialise together). These oversights represent the kinds of intervention problems encountered when elevating one set of knowledge (such as science) over other knowledges (such as economics or agronomics).

Reef Protection Group scientist participants showed they were authoritarian and coercive about *their* science and *their* knowledge to the point that they missed opportunities to collaborate more effectively with the sugar industry and their association representatives. There was no discussion of potential for a reassessment of the contested science or compromise over the recommended practice. For the Reef Protection scientists this was a valiant and virtuous battle for the *right* course of action to protect the highest environmental values. They *knew* and they *knew better*. The Reef Protection Group scientists constituted and were constituted by a dominant disciplinary discourse of environmental science. The practices of the discipline of science, including the norms, mores and validating systems elevated scientific knowledge to a higher status than that that of growers' or rural peoples' knowledge (RPK). The scientists enjoyed the prestige of the knowledge elite, while RPK was considered unscientific and anecdotal knowledge and as a result was relegated to a lesser level as subjugated knowledge.

A Foucauldian theoretical framework thus enhanced an analysis of the knowledge/power discourses of the discipline of science. When science is used in a dispute it cannot be considered separate from the politics of environmental decision-making. Policy-makers depend on the special status of science as the most reliable and credible form of knowledge. At the same time this supports the assumption that science can operate outside of the sphere of political and social influence that surrounds environmental issues. But science is not apolitical and knowledge and decisions about environmental issues are inevitably linked to the different stakeholders' values and political positions, including those of the scientists and experts involved.

Since the post-Enlightenment period there has been a demand for the state to increase the arena of its control to include protection of the environment as an extension of its shepherding role. Post-war fears of new and invisible risks, coupled with a growing reliance on expert advice on how to manage complex risks, made for a natural progression of a growing bureaucracy devoted to environmental policy. A key finding from a Foucauldian analysis has been the profound level to which scientists have gained influence and power in the arena of environmental policy development. The increased power of the epistemic community of Reef Protection scientists has occurred through their access and advice to bureaucrats and the state, provision of esteemed information to Green NGOs and the trust and respect afforded them by the public and the news media. The discourse of environmental science and environmental management aims to 'discipline' the farmers to perform a particular way. This manner of developing environmental policy has manifested a form of governance that is an extension of Foucault's concept of governmentality known as ecogovernmentality.

9.3 Limitations and Implications of the Study

This study presents only one analysis and I do not claim that it is the only possible one or that it is the 'true' one. This research reveals that relying on expert scientific advice to achieve sustainable agricultural industry outcomes will not work without consulting the farmers involved. The research also suggests that often too few people comprise an epistemic community and wield the power to decide what constitutes an environmental problem and how it should be managed. Value-laden science can often have expensive economic consequences that scientists have not had to be held accountable for, demonstrated in cases such as Haas' study of the international banning of CFCs (Haas, 1992a, 1992b) and Wynne's (1992a) famous study of the relationship between Cumbrian sheep farmers and scientists which demonstrated great cost to the community at the expense of scientists ignoring the farmers knowledge. The government scientists failed to listen to the farmers because they lacked the proper scientific

training and credentials. Carolan (2006e) would accredit this absence of training as contributing to a lack of 'interactional expertise'. It could be said that the scientists in this study lacked the interactional expertise that would have unearthed farmers' knowledge and integrated it into the broader decision-making process. Allan (2005), Carolan (2006e) and Glyde and Vanclay (1996) assert that scientists *should* be open to the possibility that they could learn something from farmers. But this is difficult to achieve when the discourses are incommensurable and tend to reinforce the differences between scientific and farmer knowledge. Perhaps engaging environmental scientists in discussions about how to incorporate local rural people's knowledge is one way forward.

The decisions that farmers make are based on experience, tradition, observation and intuition. This method of making decisions may not be considered scientific but that is not a good reason for dismissing or undervaluing it. Scientific understanding is also partial and is not always well suited to managing the highly complex ecosystem on which we depend. The models of soil processes, hydrology, climate and plant growth are continually becoming more sophisticated, but a complete understanding of all the mechanisms involved may never be understood and it may be impossible to measure all of the important parameters. Models are also limited in that they are a virtual representation of reality and totally dependent on the data selection process for creating the model. Scientific understanding does not always incorporate the complex human interrelationships at the crux of each environmental issue. A land management model would also need to include the social, political, economic and personal factors that influence land management, and then be able to adapt and change as these elements change (Nelson, 1997). Models are better used for learning and developing understanding than as prescriptions for management actions.

The best examples of sustainable land management come from places where the human manager has become part of the system and where traditions, observation, intuition and a caring attitude have led to practices that maintain long-term stability of the system (Nelson, 1997). Individual land managers value and use both scientific and non-scientific principles. The non-scientific principles warrant more attention and value from the scientific organisations that concern themselves with the environmental management of farming practices. As Funtowicz and Ravetz (2008:364) claim "in many policy issues involving science, our ignorance is more important than our knowledge". In an effort to make environmental policy decisions that affect farmers more sustainable and more democratic we need to incorporate farmers' knowledge and experience in the decision-making process. This would normally be achieved through the usual channels of political representation of elected representatives (politicians) who are thereby

answerable to the electorate. However, with an urban population that far exceeds the rural population in Australia, even though the nation relies on its rural industries for domestic supplies of food and for income from exports, there remains the challenge of respect for farmers' experience and knowledge.

This study has implications for the future of environmental policy development affecting the sugar industry in the Wet Tropics and Australian farming industries in general. The results of an EMT analysis made visible the faults in the design of the recommended environmental practice, or innovation, and exposed the weaknesses in the methods chosen to implement enforced policy measures. Similarly, the Foucauldian analysis revealed that farmer knowledges need to be made visible in disputes over environmental policy. However, the deference paid to science and scientists is well entrenched in Australian society and likely to continue. What this means for the future for farming is unclear.

This study also points in a few directions for future research. Further research projects could examine cases and methods of including the participation of farmers in the decision-making process of the farmer adoption. In particular, the best cases to examine first would be where farmers have been much more collaboratively involved in the development of modified practices that do not ignore the economic, social, political and cultural issues that farmers face. The use of a Foucauldian theoretical framework offers those who study barriers to adoption of farming practices a much better opportunity for understanding the machinations of knowledge and power in the policy development process. Cross-disciplinary studies of farmer adoption provide a way for scientists to better understand and appreciate farmers and their knowledge and experience. Scientists studying and working alongside social scientists and farmers conferred with equal status can learn from each other and provide knowledge outcomes that offer more than the sum of their individual parts.

More interdisciplinary post-graduate research projects could be encouraged that combine theoretical frameworks from sociology, economics, the environment and scientific perspectives to gain deeper understandings of the machinations of environmental issues. The STEPS Centre (STEPS Centre, 2010) based in Britain provides one example of a step forward in this direction. It is an interdisciplinary global research and policy engagement hub, funded by the Economic and Social Research Council (ESRC). They bring social and natural scientists to work together in groups ranging in composition from anthropologists, engineers and ecologists, to economists, physicians and physicists. They have overturned the tradition of working separately to try and achieve a breakthrough in thinking and action.

9.4 Reflections

Some may not like personal reflection in the power and dominance of environmental epistemic communities in the Australian political scene. Of concern is the invisibility of the lack of democratically inclusive processes with regard to environmental policy making. Living in an era of ecogovernmentality masks the knowledge/power processes at play. I look back through the looking glass at my former beliefs as an environmental scientist and see a virtuous scientist able to justify a position and policy measure from the perspective of using the *right* course of action and working for the higher good of society to protect something that I valued. I remain an environmental scientist but I have gained a new way of looking at the world.

This thesis is not an attack on science and scientists, rather, here is an opportunity for a better understanding of the limitations of science and scientists and their role in subjugating other knowledges. Scientists are merely experts, like every other expert on the political stage. Their knowledge is no more immaculate than that of economists, health policy makers, police officers, legal advocates, weather forecasters, travel agents, car mechanics or plumbers (Collins and Pinch, 1993). Environmental change is nothing new, but is rather a constant part of life and history of our planet. Rather than approaching environmental problems as a 'crisis' for the protection of that environment, based on a dominant ideological idea of how that environment is supposed to look, a sociological view of the environment can offer a different perspective. A sociological view warrants a deeper philosophical approach and it questions the social, political and cultural construction of an environmental problem.

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Appendix 1 Copy of published article by Benn *et al*, 2010

THIS ARTICLE HAS BEEN REMOVED DUE
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Benn, Karen E., Elder, Jan, Jakku, Emma, and Thorburn, Peter J. (2010) The sugar industry's impact on the landscape of the Australian wet tropical coast. Landscape Research, 35 (6). pp. 613-632.

Appendix 2 Uptake of Good Farming Practices by Sugarcane Growers (Wrigley, 2006).

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Appendix 3 Six Easy Steps

Six Easy Steps to improved nutrient management (Schroeder, *et al.*, 2005).

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Appendix 4 Interview Guides for Growers, Industry Members and Industry Stakeholders

Interview Guide for Growers

Farm history and details

Size of farm?

All sugarcane (what percentage)?

Proximity to 'town'?

How long has this farm been in the family?

Father grew sugar here too?

Changes to the farm since it has been in the family

Appearance: what it looked like when you/family took over the land?

Crops: Always grown only sugar?

Other crops or cattle?

Changes made while in the family?

By whom?

Personal details

Family size

Ages of children

Family members participation in farm work (wife/husband, children, parents)

Family's future on this land

Are any of your kids interested in taking over the farm?

Will kids continue with sugar?

Would any of your children take over the farm as part of a lifestyle choice – even if they had to supplement their incomes with other work?

Soil types and slope

Soil types?

Slope on your land?

What proportion is under slope?

What gradient?

Do you farm any sugarcane on slopes?

Slope problems?

How do you deal with the problems?

Is it expensive or time consuming?

The wet and the dry seasons

Drainage issues?

Run-off?

Leaching of chemicals or nutrients?

Management issues?

Run-off from your property during the wet?

Why?

What management measures?

Any support with run-off issues?

Where/who from?

Lots of talk about run-off affecting the waterways and the Reef. What is your view?

Does your farm contribute any run-off to the Reef?

Or any leaching of chemicals?

How much is sugarcane contributing to the run-off to waterways and the Reef?

Other environmental impacts?

Any suggestions about how to deal with it better?

What needs to happen in the sugar industry for these issues to be dealt with?

What barriers for farmers applying these practices?

Problems during the dry season?

Management?

What support?

Recommended practices

Lots of recommended practices.

Do you receive mainly unsolicited information about recommended practices or do you request the information?

What information?

From whom?

How much do you rely on the internet for information? Sources?

Which practices have you taken on?

Which ones not interested in?

Who do you rely on most for information?

Pivot, BSES, Mossag, DPI, Canegrowers, FNQ NRM Ltd, other?

Do other farmers here take on recommended practices?

Same as you? Different?

Why do you do it differently?

Have you ever been involved in any trials/experiments?

Or any other funded projects?

Do you think that the sugar industry is open and flexible to change? All kinds of change? Why is that?

Are some parts of the sugar industry more open to changes? Which parts?

What changes are taken on most readily? Why?

Sustainability

Heard the term sustainability? It seems to be used a lot lately?

This term is used in many different ways. What does it mean to you?

How do the following groups use this term do you think?

Ag services/BSES, Scientists, FNQ NRM Ltd, Government, The Mill, Other farmers (transporters and harvesters), People living in the nearest towns, People living in the big cities

Does being on a farm give you a different point of view?

What is sustainable sugarcane farming?

What is a sustainable sugar industry?

How are these two things similar or different?

How is the current economic situation affecting you?

You

The farm

Overall sustainability of the industry?

Industry structure and the value chain on a local level

The sugarcane industry, on a local and regional level, has a lot of measures built into it to spread the wins and losses. Some examples include the pricing formula and the methods for harvesting and transporting the cane.

How important are these measures?

What if they ceased to exist?

What are the pros and cons of these measures?

Can you give any examples?

The sugar industry was highly regulated in the past. Now deregulated. What are the consequences of deregulation – both positive and negative?

How has deregulation impacted on you personally?

And on the sugar industry?

If you were making changes, where would you make the changes?

The Mill

The Mill is such an important part of the sugar industry regionally. How does the way the mill is run and structured affect

Mill board/staff decisions?

Opportunities for change in the sugar industry?

What role does Mill play in future of sugarcane farming in this region?

How flexible is Mill to other opportunities within the sugar industry?

Or with other potential income streams?

The future

Industry future for sugarcane here? In the near future? In the distant future?

How will it look in 5, 10, 20 years?

How might it be different?

How much flexibility is there for changes in the growing, milling, harvesting, transporting of sugarcane?

Reef Plan

Have you heard of the Reef Plan?

What have you heard?

Is it affecting you personally? Now? In the future?

Is it affecting the industry in this region?

Whole industry?

What measures could be taken to reduce run-off of sediment and nutrients to waterways and the Reef?

Personal measures?

Economic situation

Does cane growing provide you with an acceptable living? Elaborate

How good a living do you make from growing sugarcane?

Do you or the family have other sources of income?

Does it help to subsidise farming activities?

Is it leading to greater diversification of farming activities?

Does it make you think about leaving sugarcane growing?

Re-iterated questions

If absolute freedom, what changes would you make to farm and farming practices?

What stops you from making these changes?

Finances, family pressures/responsibilities, society, health, mill, other farmers, government?

Thought of diversifying, as well as growing sugar?

If so, what?

Discussed this with your family? With other people in the industry? With extension officers?

What responses did you get?

Industry memberships

Do you belong to any boards, associations, or committees relating to the sugar industry? Which ones? What role?

Conclusion

Any ideas on what would assist sugarcane farmers to meet environmental objectives and remain economically viable?

Interview Guide for Industry Members and Industry Stakeholders

Role or interest in the sugar industry

What is your line of work?

How does it relate to the sugar industry?

Do you work directly with sugarcane growers? Millers? Harvesters? Transporters? Refiners? Marketers?

What is your connection with this/these sectors?

Does your job depend on the sugar industry (as a client?) in any way?

Does the sugar industry depend on you and/or your business/work?

Does your job/role support the sugar industry? Or regulate? Or direct? Or investigate?

Or is it in an antagonistic position to the industry?

Environmental performance of industry?

How would you rate the environmental performance of the sugar industry? Elaborate and provide details

Recommended practices

Do you think that the majority of sugarcane growers are applying the recommended farming best management practices?

What do you base this on?

Where do you get your information?

Do you know the statistics?

Do you think that most sugarcane growers have a good understanding of soil health issues and management?

Do you think that most sugarcane growers are applying fertilizers according to soil tests and recommended does?

Do you think that they have a good understanding of drainage issues and how to manage them?

Do you think that they are managing the run-off of sediments and nutrients well from their farms? Elaborate

Do you think they understand about leaching of nutrients and chemicals from their land? Are the majority managing this well?

What are your thoughts about the performance of sugarcane farmers with regard to run-off to the Reef and local waterways?

How much do you think that sugarcane growing is contributing?

Do you think that the sugar industry is having other environmental impacts?

What do you think needs to happen to improve the environmental performance of the sugarcane industry regionally?

Sources of information

Where do you think that sugarcane growers get most of their recommended practices information from?

Where do you think that other parts of the sugar industry get their recommended practices information from?

Sustainability

Do you think that growing sugarcane is sustainable? Elaborate

Do you think that the sugar industry is sustainable? Elaborate

Do you think that growers are open and flexible to change? Elaborate

Do you think that the sugar industry (all of its parts) are flexible and open to change? Elaborate

What would it take to make the industry sustainable – or more sustainable?

How do you think that the current economic situation is affecting the growers and the rest of the sugar industry? Elaborate

The Mill

What is the mill doing with regard to supporting or encouraging growers to adopt best management practices? Elaborate

Has the mill changed/updated its business or operational practices in recent years? Environmentally? Business opportunities? Elaborate

Industry structure

What is your understanding of the industry structure? (Is respondent aware?)

What are your thoughts about the industry structure for the growing, harvesting, transporting, milling, refining, marketing of sugarcane?

What are industry's strengths and weaknesses?

Compared to other models in Australia or overseas? Elaborate

What would be your advice to the milling sector of the industry?

Ideas for mill to be more sustainable?

The future

What do you think is the future of the sugar industry here/ in Far North Queensland?

Do you think that environmental regulations will be introduced to the sugar industry? Elaborate.

Where do you stand on this?

Reef Plan

Have you heard of the Reef Water Quality Protection Plan?

Do you think that the Reef Plan is affecting growers? How? Elaborate

Is the Reef Plan affecting you? (If a miller/transporter/harvester/marketer)

Do you play a role in the development or delivery of the Reef Plan? (other stakeholders)

Grower income and economic situation

Are you aware of the current economic circumstances for growers? Elaborate

What do you think would be an acceptable living for growers? Explain/elaborate

Industry organisations

What are your thoughts about other sugar cane industry organisations? Helpful? Hindrance? Elaborate.

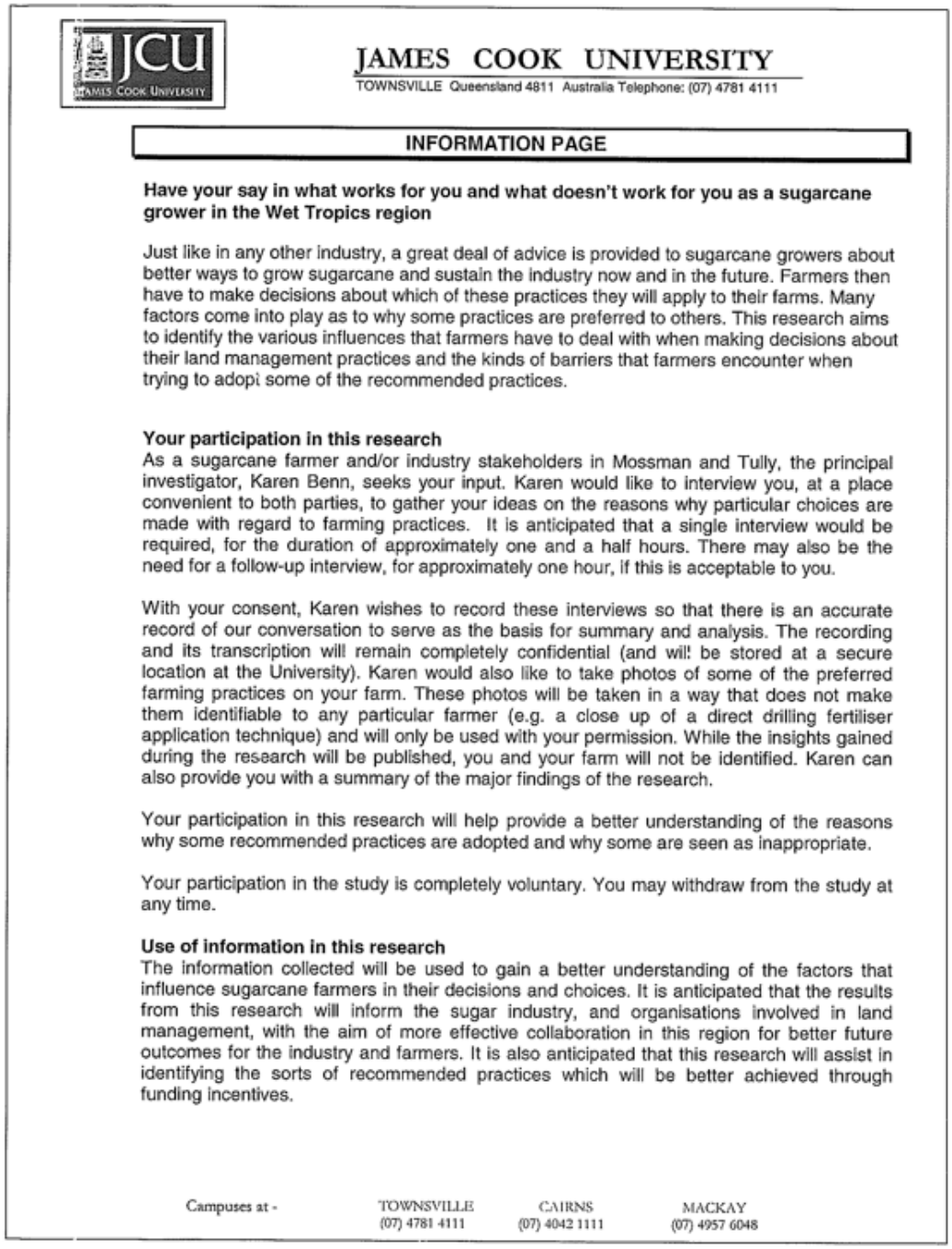
Other ideas/thoughts

What are your thoughts and/or ideas with regard to the structure and culture of the sugar industry?

The barriers/issues?

How things could be improved?

Appendix 5 Interviewee Information Page



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INFORMATION PAGE

Have your say in what works for you and what doesn't work for you as a sugarcane grower in the Wet Tropics region

Just like in any other industry, a great deal of advice is provided to sugarcane growers about better ways to grow sugarcane and sustain the industry now and in the future. Farmers then have to make decisions about which of these practices they will apply to their farms. Many factors come into play as to why some practices are preferred to others. This research aims to identify the various influences that farmers have to deal with when making decisions about their land management practices and the kinds of barriers that farmers encounter when trying to adopt some of the recommended practices.

Your participation in this research
As a sugarcane farmer and/or industry stakeholders in Mossman and Tully, the principal investigator, Karen Benn, seeks your input. Karen would like to interview you, at a place convenient to both parties, to gather your ideas on the reasons why particular choices are made with regard to farming practices. It is anticipated that a single interview would be required, for the duration of approximately one and a half hours. There may also be the need for a follow-up interview, for approximately one hour, if this is acceptable to you.

With your consent, Karen wishes to record these interviews so that there is an accurate record of our conversation to serve as the basis for summary and analysis. The recording and its transcription will remain completely confidential (and will be stored at a secure location at the University). Karen would also like to take photos of some of the preferred farming practices on your farm. These photos will be taken in a way that does not make them identifiable to any particular farmer (e.g. a close up of a direct drilling fertiliser application technique) and will only be used with your permission. While the insights gained during the research will be published, you and your farm will not be identified. Karen can also provide you with a summary of the major findings of the research.

Your participation in this research will help provide a better understanding of the reasons why some recommended practices are adopted and why some are seen as inappropriate.

Your participation in the study is completely voluntary. You may withdraw from the study at any time.

Use of information in this research
The information collected will be used to gain a better understanding of the factors that influence sugarcane farmers in their decisions and choices. It is anticipated that the results from this research will inform the sugar industry, and organisations involved in land management, with the aim of more effective collaboration in this region for better future outcomes for the industry and farmers. It is also anticipated that this research will assist in identifying the sorts of recommended practices which will be better achieved through funding incentives.

Campuses at - TOWNSVILLE (07) 4781 4111 CAIRNS (07) 4042 1111 MACKAY (07) 4957 6048

ADMINISTRATIVE DOCUMENTATION HAS BEEN REMOVED

Appendix 6 Informed Consent Form

ADMINISTRATIVE DOCUMENTATION HAS BEEN REMOVED

Appendix 7 Ethics Approval

ADMINISTRATIVE DOCUMENTATION HAS BEEN REMOVED

Appendix 8 Participant Details [59]

Group 1 Sugar Industry Participants

Sugarcane Growers

Code	Details on participants
PG 1-3	Pilot Growers all from the Mulgrave mill area close to the city of Cairns (one additional grower's partner also participated but was not included in the total number).
MG 1-16	Mossman growers (an additional nine of the growers' partners also participated but were not included in the total number). Two of the growers were women and seven were young growers.
TG 1-30	Tully growers (an additional four of the growers' partners also participated but were not included in the total number). One of these growers was a woman and nine were young growers.

Sugar Mill staff (from four different mills in the Wet Tropics region)

Code	Details on participants
IM1	Mill board member
IE2	Mill extension officer
IM6	
IM14	Mill CEOs
IM28	
IM3	Mill operations manager
IM23	Mill marketing and economics manager
IM11	Mill transport manager

[59] Please note that minimum information is supplied about each participant for confidentiality purposes.

Industry Association members

Code	Details on participants
IA9	Canegrowers Association environmental manager
IA21	CEO Canegrowers Association & member of Allied Sugar Industry Alliance
IA17	CEO Queensland Sugar Limited
IA29	General Manager Australian Sugar Milling Council

Group 2 Reef Protection Participants

Government Extension Officers involved with the sugar industry

Code	Details on participants
GE4	Bureau of Sugar Experimental Stations (BSES) Extension services
GE5	Department of Primary Industries and Fisheries (State) Extension services
GE12	Department of Natural Resources (State) Extension services
GE13	Department of Primary Industries and Fisheries, then later Department of Natural Resources Extension services and policy adviser
GE20	Department of Primary Industry extension services (and psychologist)
GE25	Far North Queensland Natural Resource Management Ltd (Terrain) Extension officer

Government Policy makers involved with the sugar industry

Code	Details on participants
GP18	Great Barrier Reef Management Park Authority policy manager for water quality
GP26	Federal government policy advisor/consultant for agriculture
GP30	Department of Agriculture, Forestry and Fisheries (Federal) policy manager
GP32	Far North Queensland Natural Resource Management group (Terrain) CEO and policy advisor to federal government
GP33	CEO Reef and Rainforest Research Centre, Marine and Tropical Sciences Research Facility and Reef Plan policy advisor

Scientists from research institutions involved with the sugar industry

Code	Details on participants
GS7	Scientist with Sugar Research and Development Corporation
GS8	Research and extension services CSIRO (agronomy)
GS19	Scientist with Australian Institute of Marine Science (water quality)
GS24	Research and extension services CSIRO (soil science)
GS31	Scientist with Australian Centre for Tropical Freshwater Research (water quality)

Green group representatives

Code	Details on participants
GNGO10	(Northern Queensland) Manager Australian Conservation Foundation
GNGO15	Manager Cairns and Far North Environment Centre
GNGO6	WWF representative working on projects with the sugar industry and Mossman Mill

Tourism industry representatives

Code	Details on participants
T22	Quicksilver manager (Barrier Reef cruises)
T27	Port Douglas and Daintree Tourism manager

Appendix 9 Themes that emerged through the interview process and data analysis

Sustainability	
Sugar Industry Views	**Reef Protection Views**
Sustainable means economically viable first.	Sustainable means environmentally viable first.
The experts put environment before farmers and farming.	Growers put profits before environment.

Growers and Farming Practices	
Sugar Industry Views	**Reef Protection Views**
Farmers create income and work, other economic activity and create food.	Farmers create sugar (inference is that it is not good for you).
Farmers improve the land.	Farmers are environmental vandals.
Farmers care for the land.	Farmers are ignorant, stubborn and recalcitrant.
Farmers create towns and community and used to be the unsung heroes.	No need for farming in the Wet Tropics.
	Eco-tourism is better, with more income.

Science, Technology and Expert Advice	
Sugar Industry Views	**Reef Protection Views**
Science solves problems, makes improvements to industry that produce economic benefits.	Science solves problems, makes improvements to industry that produce economic benefits.
Scientists and experts think they know the answers.	Scientists and experts know the answers.
Scientists will not listen to us about environmental issues and they get it wrong, they make things worse.	Growers don't listen to us about environmental issues – we solve problems that produce environmental benefits.
Scientists are elitist, do not ask us what we know.	Scientists know better than the farmers.
Scientists and experts make the rules.	Farmers would benefit from our advice.
They say we are damaging the reef, but we are not. Where is their evidence?	They are damaging the reef and need to change practices or be forced to.

Government	
Sugar Industry Views	**Reef Protection Views**
Government does not support us like they used to.	Government is responsible for people and environment.
Environmental policies make our costs go up, but our profits are going down.	Government needs to protect the environment
Regulations are not necessary. They are expensive and we bear the costs.	Government needs to be firmer and need to introduce regulations.
Government has gone over to the greenies' side. The greenies have the power over government now.	Government must heed expert advice from scientists who produce evidence.

Regulations	
Sugar Industry Views	**Reef Protection Views**
More and more regulations, so why bother to continue farming? Makes farming more costly.	Farming is exempt from the EP Act. Therefore need special regulations to force them to comply (with regulations).
Regulations just make 'them' feel better. They do not fix anything because we are not damaging the GBR.	We tried explaining the science and showed them the statistics/evidence on the damage they cause and provided them with scientific advice on how to manage the problem – but they won't listen. Need regulations.
They tell us how to use fertilisers but it is not their land or their livelihoods. They don't have to bear the consequences of getting it wrong.	Need to bring fertiliser companies on board to help us manage how much fertilisers growers use.
Less fertiliser equals less volume of crop, so we lose income, but there is no compensation.	Growers need to use less fertilisers to protect the environment and they will save money and still grow a crop as well.

Mills	
Sugar Industry Views	**Reef Protection Views**
Some growers say that they do what the mills tell them to. Some growers say that mills do not tell them *how* to grow their cane.	If mills tell them what to do, then we need to exert pressure on mills to get growers to change their practices.
We can't exist without them and they can't exist without us.	The industry is complex and has internal problems, so regulations would solve all that.
There are times growers argue with mills, but they each support each other when times are tough because they are co-dependent.	The structure or culture of the industry is not important. Can't see how it affects management of the issue if regulations are applied.

Green NGOs	
Sugar Industry Views	**Reef Protection Views**
Greenies (WWF) can be helpful sometimes, such as for eco-accreditation for potential new products from sugarcane.	WWF is working with Mossman mill and growers to find eco-markets for new products from eco-accredited sugarcane.
Greenies are adversarial and accuse us in the media of harming the GBR.	Growers are killing the coral reefs with their sediment and nutrient run-off.
Greenies cannot see what we have already done for the environment, such as GCTB.	Growers do not do enough for the environment and think more of profits.
Greenies do not understand what we do, listen to incorrect science and will not listen to us.	Growers are stubborn, ignorant and will not listen to good sense, the scientific evidence or us.

Grower Adoption	
Sugar Industry Views	**Reef Protection Views**
We have adopted many of the recommended practices.	They resist good scientific advice, which can help them be better farmers.
We've tried almost every recommended practice – other than previously tried ones that have failed, or ones that to us will obviously fail.	They avoid change and can't see how our advice can help them. They are ignorant and backward, old-fashioned, uneducated and stubborn.
We prefer innovations that improve our profit margin (or save time).	If they are going to be resistant, they need to be forced to change their practices.
We don't like recommendations that will cost us more in time and money, without any pay-off – especially those that cause us to lose more income.	There are some 'good' growers who 'understand' and adopt the recommendations.