

University of
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Sustainable Farm Dam Management Pressures: Farmers' Strategic Responses

by

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List of abbreviations

Abbreviation	Meaning
ACT	Australian Capital Territory
AGGA	Australian Government Geoscience Australia
ANCOLD	Australian National Committee on Large Dams
ANRA	Australian Natural Resources Atlas
COAG	Council of Australian Governments
DPIW	Department for Primary Industries and Water (Tasmania)
DPIWE	Department of Primary Industries, Water and the Environment (Tasmania)
DPIPWE	Department for Primary Industries, Parks, Water and the Environment (Tasmania)
DSC	Dam Safety Committee (New South Wales)
DSE	Department for Sustainability and Environment (Victoria)
DV	Dependent Variable
EFA	Exploratory Factor Analysis
IWRM	Integrated Water Resources Management
IV	Independent Variable
LDC	Lange Dames Campbell (SA) Pty. Ltd
m	Metres
MDB	Murray-Darling Basin
ML	Megalitres
MMR	Moderated Multiple Regression
ModV	Moderator Variable
MR	Multiple Regression
n	Number of subjects
NSW	New South Wales
NT	Northern Territory
NWI	National Water Initiative
QLD	Queensland
SA	South Australia
Sig.	Statistical significance
SMEC	Snowy Mountains Engineering Corporation
SPSS	Statistical Program for the Social Sciences
TAS	Tasmania
VIC	Victoria
UNDESA	United Nations Department of Economic and Social Affairs
UNDISR	United Nations Secretariat for the International Strategy for Disaster Reduction
UNIPCC	United Nations Intergovernmental Panel on Climate Change
UNWCED	United Nations World Commission on Environment and Development
WA	Western Australia
WMPAs	Water Management Partnership Agreements

Summary

Water management is a critical issue throughout the world because when water is scarce it leads to droughts, and when excessive it leads to floods, particularly in countries with high variability in rainfall, exacerbated further by the effects of climate change. Storing rainfall in farm dams can help mitigate the effects of droughts and floods but only if managed sustainably, which is generally not the case world-wide. Hence, sustainable storage of surface water in farm dams is an area requiring urgent attention. In Australia, where there are estimates of at least 735,000 farm dams, the sustainable management of agricultural surface water storage presents a significant dual-extreme problem for policy and practice: in times of drought, there is an incentive to store more water than entitled leading to an unfair sharing of limited surface water resources between farmers, communities and the environment; and, in times of flood, an unsafe structure can cause catastrophic consequences downstream.

Despite the importance of the problem of unsustainably managed farm dams, there is evidence of deficiencies and inconsistencies in farm dam management institutional environments across Australia. When coupled with evidence of widespread unsustainable farm dam management practice, how farmers respond to sustainable farm dam management pressures from their institutional environments, such as those from regulators, neighbours, industry bodies, and the community, becomes a critical concern. Because of the need for understanding of the relationship between sustainable farm dam management pressures from the institutional environment and the farmers' resistance to these pressures, the research asks the question: *How do farmers respond to institutional pressures to manage farm dams sustainably to achieve equity between stakeholders seeking this limited surface water resource and the safety of communities?*

This study aims to address the problem of unsustainably managed farm dams through application of Oliver's (1991) framework integrating resource dependence and institutional theories to explain farmers' resistance to institutional pressure to manage their dams in a sustainable way. The study employs a quantitative survey design in order to compare sustainable farm dam management response in four states across Australia representing diverse sustainable farm dam management institutional environments: South Australia, New South Wales, Victoria and Tasmania. Sampling from these test states resulted in telephone survey data collected from 404 participants.

Results from multiple regression analyses suggest that the institutional antecedents of context, control, content, constituents, and cause predict farmers' compliance with or resistance to pressure to manage farm dams in a sustainable way. More specifically,

where there is uncertainty, disconnectedness, or a lack of voluntary diffusion, sustainable farm dam management strategies will need to be tailored differently from environments where pressures provide certainty and control over farm dam decisions and are consistent with farm goals. Institutional actors such as industry bodies, community groups and banks are beneficial and can often help drive an acquiescent response to pressure in strong institutional environments where legal coercion to manage dams sustainably is highly resisted. Reputational and economic incentives for good farm dam management will encourage low resistance to pressures for sustainable behaviour independent of the strength of the institutional environment of the farmer.

The study makes three main contributions. Firstly, it provides in-depth understanding of a complex water storage management problem in critical need of research through broad-scale empirical insight. Secondly, it advances Oliver's (1991) theoretical framework as a lens for investigating the institutional foundations of sustainable responses to problems of water resource management more broadly. Thirdly, it provides key practical guidelines to facilitate a sustainable dam management response from farmers in various institutional environments.

The findings provide academics, farmers, policymakers and those in the rural sector, with recommendations and implications that can be used to improve equity between stakeholders and the safety of communities living in catchments containing unsustainably managed farm dams. Ultimately, in times of unprecedented increases in weather extremes and demands on agricultural resources, this research develops and extends understanding of resistance to institutional pressures in order to provide guidance for the future of agricultural surface water storage management in catchments around the world.

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List of publications related to this thesis

Refereed journal publications

- Pisaniello, J.D., Tingey-Holyoak, J. and Burritt, R.L. (2012) 'Appropriate Small Dam Management for Minimising Catchment-wide Safety Threats: International Benchmarked Guidelines and Demonstrative Cases Studies from Australia', *Water Resources Research,* 48, W01546, doi:10.1029/2011WR011155, 16p.
- Tingey-Holyoak, J., Pisaniello, J.D. and Burritt, R.L. (2012) 'Private Dam Safety Accountability and Assurance: Moving from Minimum to International Best Practice Policy Benchmarks', in *Social and Environmental Accounting: Research Advances and New Perspectives*, P.Arena and E.Cardillo (Eds.), ARACNE Editrice S.r.l., Rome, pp.199-222.
- Pisaniello, J.D., Burritt, R.L. and Tingey-Holyoak, J. (2011) 'Dam Safety Management for Sustainable Farming Businesses and Catchments', *Agricultural Water Management*, Vol.98, Iss.4, pp.507-515.
- Tingey-Holyoak, J., Pisaniello, J.D. and Burritt, R.L. (2011) 'Analysis and Application of International Dam Safety Policy Benchmarks', *Benchmarking: An International Journal*, Vol.18, No.2, pp.301-317.

Refereed conference proceedings

- Tingey-Holyoak, J., Burritt, R.L. and Pisaniello, J.D. (2012) 'Living with surface water shortage and surplus: the case of sustainable agricultural water storage', *Tapping the Turn*, 16-18 November 2012, accepted for presentation.
- Pisaniello, J.D., Tingey-Holyoak, J. and Burritt, R.L. (2011) 'Accounting for On-Farm Water Storage Practices in the Face of Dual-Extreme Cumulative Impacts and Threats in Catchments', *Acqua Alta,* Hamburg, October 2011.
- Tingey-Holyoak, J., Pisaniello, J.D. and Burritt, R.L. (2010) 'Analysis and Application of International Dam Safety Policy Benchmarks', *CSEAR2010*, Catania, Italy, September 2010.

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- Pisaniello, J.D., Tingey-Holyoak, J. and Burritt, R.L. (2012) 'Appropriate small dam management for minimising catchment-wide safety and drought threats', *UNESCO Global Water Forum*, http://www.globalwaterforum.org/2012/04/03/appropriate-small-dam-management-for-minimising-catchment-wide-safety-and-drought-threats/.

Declaration

I declare that:

- this thesis presents work carried out by myself and does not incorporate without acknowledgement, any material previously submitted for a degree or diploma in any university, and
- to the best of my knowledge, it does not contain any materials previously published or written by another person except where due references is made in the text; and all substantive contributions by others to the work presented, including jointly authored publications, is clearly acknowledged.

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Joanne Tingey-Holyoak

1st June 2012

Chapter 1

Introduction

1.1 Background, significance and purpose

The critical area of concern for this study is the need for sustainable management of farm dams. In times of water scarcity, sustainable agricultural water storage management is an essential response to environmental pressures (Loucks, 2000). However, there are problems around the world with farm dams as many are holding more water than they are entitled to because of unsustainable management practice, in addition to thousands of dam structures which have failed and many more posing significant safety threats (Pisaniello & McKay, 2007; Pisaniello *et al.*, 2012). Farm dams form critical infrastructure of most farming businesses for stock and domestic watering and crop irrigation and thus are a vital part of agriculture (Lewis, 2002). If not managed sustainably at the on-farm level farm dams can generate exacerbated drought and flood impacts/threats to farmers, communities and the environment at the catchment-wide level (Pisaniello *et al.*, 2012). For example, many farmers storing more than their entitlement to surface water through behaviours such as spillway blocking, leads to unfair sharing of surface water during times of drought and unsafe dam structures during times of extreme rainfall (Pisaniello *et al.*, 2011a). In effect, if when faced with institutional and resource dependence pressures a farmer's strategic dam management response is unsustainable, this contributes significantly to the broader water management problem. The purpose of this study is to investigate, through an empirical study of farmer perceptions, the challenge of farmer resistance to pressures to manage dams sustainably. These pressures are only exacerbated in extremes of climate change induced drought and flood (UNISDR, 2011) and thus for surface water storage to be sustainable for the future of agriculture, the response of farmers to institutional pressure to manage farm dams sustainably warrants urgent attention.

1.2 Aims of and justification for this research

Sustainable management of water in Australia is a significant issue, not only because of the high variability in rainfall (Lake & Bond, 2006), but because of the perceived failures of stakeholders at all levels to action a response to the critical agenda of water sustainability (Livingston, 1995; Bjornlund & McKay, 2002; McKay, 2005). When faced with a growing resource problem it is important to understand the relationship between the institutional

environment, made up of fundamental political, social and legal rules and norms (Davis & North, 1971) and an organisation's strategic response to pressures from that environment (Cashore & Vertinsky, 2000). Farmers throughout Australia face continually changing institutional environments and must implement response strategies to meet the circumstances. Yet, despite research and overseas experience demonstrating that the impact of unsustainably managed farm dams can have catastrophic impact on downstream communities and the environment, the overall sustainable management of farm dams receives insufficient and inconsistent attention from farmers, communities and key institutional actors (Pisaniello, 2009). Therefore, the main aim of the research is to examine the resistance of farmers to institutional pressures to manage dams sustainably.

1.2.1 Real-world problem

The real-world problem is unsustainably managed farm dams in catchments which has two sides explored in this research: water sharing equity and water storage safety. One of the main unsustainable farm dam management behaviours focused on in this study is the deliberate or negligent blocking of a dam's spillway, or inadequate spillway provision by farmers. This key unsustainable farm dam management practice allows farmers to store more than their entitlement and is not only inequitable, depriving downstream users and the environment of water, but also creates an unsafe dam structure. This management action of deprivation of water from downstream users can have devastating consequences for farming and other businesses, communities, and biodiversity (Tingey-Holyoak *et al.*, 2011). The situation is exacerbated because climate change is raising the frequency of droughts and floods (UNIPCC, 2007a) to which agricultural systems are sensitive (Brumbelow & Georgakakos, 2007).

This unsustainable management behaviour of withholding additional water creates an unsafe structure that harbours considerable risk of damage and disaster: in Romania, the 18m earthen Belci Dam failed by overtopping in 1991 because of inadequate and blocked spillway outlets killing 25 people (Hayes, 2010); in the United States, the 13m Kaloko farm dam in Hawaii overtopped because of blocked spillways and killed seven people in addition to widespread environmental damage (HIDLNR, 2010); and in 2009, the relatively small 10m high Situ Gintung earthen dam in Indonesia failed by overtopping causing the deaths of approximately 100 people and causing widespread damage to infrastructure in Jakarta (The Associated Press, 2009). However, farm dam failure does not only have tragic consequences at the individual level. On a cumulative scale the results of poorly managed dams can be catastrophic (Pisaniello *et al.*, 2012). Cumulative dam failures have caused disaster all around the world: in China in 1972, the Shimantan and Banquia dams failed

because of the failure of 60 upstream farm dams, resulting in 230,000 deaths (Yi Si & Dai Qing, 1998); in 1989 in the United States, the Evans and Lockwood dams, holding only 89ML and 39ML of water respectively, both collapsed in a cascade manner, killing two people (Graham, 1999); a case study of earth dam failures in Nigeria found that farmers impounding water in upstream catchments increased volumes of water released during the floods which caused the bad overtopping failure of the downstream 8,000ML public Cham dam (Umaru *et al*. 2010, p.50); in 2010, a cumulative series of private dam bursts in Brazil left 50 people dead and an estimated 150,000 homeless, with a further 200 dams reported to be at high risk of cumulative failure (Pottinger, 2010); and recently, in February 2012, the cumulative failure of farm dams in Bulgaria resulted in the collapse of a water reservoir downstream with reports of at least 10 deaths (Novinite, 2012a; 2012b).

The dual extreme risk is further increased in Australia because of its climate of extremes and as farm dams are a significant part of agricultural water storage, with estimates of over 735,000 farm dams in the country (Baillie, 2008). All around Australia, privately owned dams, farm dams especially, are storing more than their entitlement (Pisaniello *et al.*, 2011a) and have failed in the thousands (Pisaniello, 1997; 2009; Pisaniello & McKay, 2007). The Australian National Committee on Large Dams (ANCOLD) in 1992 estimated that 23% of farm dams in New South Wales[1] had failed (ANCOLD, 1992); in Tasmania approximately 500 of the 8000 registered dams have significant hazard potential (DPIWE, 2005). In Victoria at least 1000 of the 300,000 farm dams are claimed to be very dangerous (Lake & Bond, 2006) with no less than 10 significant failures having occurred in recent times (Lewis & Harrison, 2002); and, in South Australia, a 600ML farm dam on Kangaroo Island burst following severe rainfalls in 2009 causing significant damage downstream (ABC, 2009).

Despite the problems associated with unsustainable farm dams, there are currently dramatic variances in sustainable farm dam management institutional environments across Australia (Baillie, 2008; Tingey-Holyoak *et al.*, 2011). Since the Council of Australian Governments (COAG)[2] (1994) competition policy reforms pushed for improved water allocation policy, each State has taken the opportunity to look holistically at water management and revised their water laws to incorporate water sharing regulatory

[1] Australia is made up of six states and two territories. State parliaments are subject to the national constitution as well as their state constitutions and federal law overrides any state law not consistent with it. Local government bodies are created by legislation at the state and territory level (DFAT, 2008). The Australian government and states and territories responsibilities for sustainable farm dam management will be discussed in Chapter 3.

[2] The Council of Australian Governments (COAG) is a group that initiates, develops and implements national policy reforms requiring cooperative action between local, state or territory, and national government. COAG deals with major issues by cooperating on structural reform of government and on reforms to achieve an integrated national economy and a single national market (DFAT, 2008).

instruments to some degree. In certain states there has been integration of some dam safety instruments into the water sharing laws but these regulations usually only target larger dams having a considerable stand-alone hazard and omit many farm dams deemed to pose no threat to downstream communities. However, Graham's (1999) study of 23 dam failures in the United States which resulted in fatalities between 1960 and 1998, demonstrated that: (i) the failure of dams between 6.1m and 15m high (the typical height range of farm dams (Pisaniello *et al.*, 2011b)) represented 18 of the dam failures and caused 86% of deaths; and (ii) the failure of dams less than 6.1m high (that is, very small dams) represented five of the dam failures and caused 2% of deaths. In the past in Australia there have been deaths resulting from dam failure (the Briseis mining dam in Tasmania which in 1929 led to 14 deaths (Pisaniello *et al.,* 2011b)) and the current and future threat of loss of human life is real and apparent (Pisaniello & McKay 2007). Yet, it is suggested that the farm dam institutional environment is one of complacency with significant unfair water sharing and unsafe farm dam management occurring (Pisaniello *et al.*, 2011a).

1.2.2 Research problem

The above consideration of the problem of unsustainable farm dam management practice and the potential for inequitable water sharing and dam failure highlights the need for research into farmers' perceptions of sustainable farm dam management. In Australia, the high variability in rainfall creates a dual-extreme environment (Pisaniello *et al.*, 2011a): in times of drought, economic pressures on farmers (Gunningham, 2007) increase the desire to undertake unfair water sharing behaviour to store more water (Falkenmark & Folke, 2002). Then, in times of flood, the structure is compromised and threats to safety are subsequently increased. Large differences in sustainable farm dam management equity and safety mechanisms in institutional environments around Australia further complicate the issue. Because of the potential impact and threat of a dual-extreme system, farm dam water storage is an area in critical need of research into the pressures that can cause a sustainable management response from farmers.

Therefore, the main research problem is **the need to understand the relationship between sustainable farm dam management pressures from the institutional environment and the farmers' resistance to these pressures**. More specifically, the research problem reflects a lack of understanding of:

(1) The equity and safety mechanisms in the institutional environment of farmers managing farm dams (Research Problem 1),

(2) The institutional pressures that can cause a sustainable farm dam management response from farmers (Research Problem 2), and
(3) The relationship between farmers' perceptions of sustainable farm dam management in relation to the institutional environment and the potential for farmer resistance to the surface water storage pressures (Research Problem 3).

Given the growing importance of policy to address key social and environmental protection issues, particularly in a setting such as Australia with increasing floods and droughts in the face of climate change (UNDESA, 1992; Whetton *et al.*, 1993), this understanding is critical for developing effective mechanisms to ensure sustainable farm dam management. The research problem highlights the urgent imperative for an investigation into the reasons for resistance of farmers to pressure to manage dams sustainably and the various strategic responses employed when this pressure is applied within a field of actors such as state and local regulators, industry bodies, insurance and financial bodies, community and environmental groups, and the media.

1.2.3 Research questions

The analysis of sustainable farm dam management pressures and responses in varying strengths of institutional environments will ultimately enable development of sustainable farm dam management key outcomes and guidelines. In order to achieve this, the research asks the main question: *How do farmers respond to institutional pressures to manage farm dams sustainably to achieve equity between stakeholders seeking this limited surface water resource and the safety of communities?*

The research question (RQ) can be addressed by three sub-questions that seek to find answers to solve the research problems:

RQ1*: What are the equity and safety mechanisms in the institutional environment of farmers managing farm dams?*

RQ2*: What are the institutional pressures that can cause a sustainable farm dam management response from farmers?* and

RQ3: *How are the farmers' perceptions of sustainable farm dam management related to the institutional environment and the potential for farmer resistance to surface water storage pressures?*

The theoretical foundation employed to answer these research questions is discussed as follows.

1.3 Institutional and resource dependence dual theoretical framework

Institutional theory can be employed as a foundation for exploration of the impacts of institutional alternatives on strategic choice (Clemens & Douglas, 2005; Okhmatovskiy & David, 2012). In addition, the relationship of the institutional environment to the farmer's strategic response to manage their dams sustainably can be examined with the help of resource dependence theory, in line with Oliver's (1991) strategic response typology. The contribution of resource dependence theory to institutional theory helps facilitate understanding of the response to institutional pressure with respect to the rational identification and use of the rare, valuable resource of water (Barney, 1991). Institutional theory and associated literature allows for identification of the key equity and safety mechanisms expected in the institutional environment, and an understanding of how institutions become similar in the face of pressure beyond economic and social optimisation (DiMaggio & Powell, 1983; Zukin & DiMaggio, 1990) and resource dependence theory allows for consideration of the motivation of individuals to optimise economic choices (Pfeffer & Salancik, 1978; Oliver, 1997). Thus the theories are complimentary especially in the on-farm setting where powerful institutions, economic considerations, and scarce resources are a way of life. The dual framework allows for investigation of the strategic response of farmers to institutional pressures to manage farm dams sustainably.

Oliver's (1991) framework has been tested empirically and applied to many issues: from university education (Etherington & Richardson, 1994) to human resources management (Goodstein, 1994; Ingram & Simons, 1995), and more recently to responses of the steel industry to environmental pressures (Clemens & Douglas, 2005). However, to the best of the researcher's knowledge, this is the first time Oliver's (1991) framework has been applied to an agricultural resource management problem. Furthermore, there is an absence of advancement of the framework to serve as a foundation for solving sustainability management problems more broadly. The dual theoretical framework applied at the representative (farmer) of the organisation (farm) level allows for focus on the perceptions of the farmer to the sustainable farm dam management activity addressed by this research. Through analysis of the sustainable farm dam management problem and dual institutional and resource dependence theoretical views, the research will meet the need for understanding of farmers' perceptions of pressure to manage dams sustainably through empirical measurement of their strategic responses analysed within a particular institutional context.

1.4 Research approach

The main approaches to addressing the three research problems are (i) a review of the literature surrounding sustainable farm dam management and strategic response to institutional pressure, (ii) a review of the sustainable farm dam management institutional environments in place in Australia, and (iii) a quantitative farmer survey in order to determine farmer perceptions. In turn, these three approaches seek answers to the research questions.

Firstly, to answer RQ1, the equity and safety mechanisms in the institutional environment of farmers managing farm dams had to be identified through a review of the farm dam institutional environments in Australia (Chapter 3). Secondly, to answer RQ2, the institutional pressures that can cause a sustainable farm dam management response from farmers were required to be identified from the related literature that facilitated development of a model that generated 16 theoretically underpinned, testable hypotheses (Chapter 4). Lastly, to answer RQ3, the perceptions of those that manage the on-farm surface water storage within the institutional environment needed to be discovered. Since a quantitative survey approach is appropriate for research problems that require self-reported beliefs, behaviours and perceptions for hypothesis testing (Neuman, 2006), the approach to the research was a structured telephone survey design. Survey research of farmers allows for capture of data uniqueness, an unbiased representation of the population of interest, and standardisation of measurement. The resulting data from the sample of 404 respondents was analysed through descriptive statistics, reliability and validity testing of variables and hypotheses testing using multiple regression analysis.

1.5 Research contributions

The study makes contributions to theory and practice and also forms a foundation for future research. The study not only provides in-depth understanding of a complex water management problem in critical need of research, but advances Oliver's (1991) theoretical framework as a lens for investigating the institutional foundations of responses to pressure to manage water storage sustainably. The study also contributes to practice through development of sustainable farm dam management guidelines that build upon the key findings of how to minimise resistance to sustainable farm dam management and encourage farmer connectedness for the equity and safety of water storage in catchments and regions.

1.6 Thesis structure

The thesis is organised into eight main chapters in order to answer the research questions, with this first chapter providing an introduction and background to the real world and research problem of unsustainable farm dam management. Chapter 2 provides a detailed literature review of the issues central to this complex area of research, by addressing the fundamentals of farm dam management and the importance of farm dams for agriculture. The chapter also focuses on definitions of sustainability and sustainable management for the purpose of this research, also providing more attention to critical unsustainable farm dam management practices before presenting the theoretical underpinnings of the study. Chapter 3 answers RQ1 by providing a detailed review of the institutional environment of sustainable farm dam management in Australia. Chapter 4 then answers RQ2 by identifying the pressures that can cause a sustainable management response and proceeds to model these pressures into 16 testable hypotheses within the context of Oliver's (1991) conceptual framework and the supporting literature from institutional and resource dependence theories. Chapter 5 presents and discusses the design and methods employed for the study. This chapter also presents the fundamentals of the statistical testing to be undertaken including the assumptions of each statistical test. Answers to RQ3 are sought from the results of the statistical analyses which are presented in Chapter 6. The results allow for examination of how farmers' perceptions of sustainable farm dam management are related to the institutional environment and the potential for their resistance to surface water storage pressure. The main research question and problem are addressed by the discussion and presentation of overarching and key findings in Chapter 7, in addition to the development of key guidelines to inform practice. Lastly, Chapter 8 presents and summarises the theoretical and practical implications of the study in addition to limitations and recommendations for future research.

1.7 Summary

The findings of this study will provide academics, farmers, policymakers, community members and others in the rural sector with implications and management guidelines that will serve to improve sustainability of Australia's storage of agricultural surface water resources. Ultimately, in times of unprecedented increases in climate extremes and demands on agricultural resources, this research provides a unique understanding of the types of strategic responses to institutional pressures that will enable development of management guidelines that assist in the future of sustainable agricultural surface water storage management.

Chapter 2

Sustainable farm dam management: Previous research and relevant theories

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2.1 Introduction

In climates of variability in water security, water is precious and so needs to be equitably distributed (Gaydon *et al.*, 2012) and safely managed (Pisaniello *et al.*, 2011b). Farm dams form critical infrastructure for most farming businesses (Lewis, 2002). Commonly for stock and domestic watering (smaller dams) and crop irrigation (larger dams), farm dams are a vital part of agriculture's future (Lewis, 2002). As highlighted in Chapter 1, there are problems all around the world with unsustainable farm dam management as many water storage structures may be holding more water than their entitlement (Pisaniello *et al.,* 2011a), posing significant safety threats (see Pisaniello, 1997; 2009; 2010; Pisaniello & McKay, 2005; 2007). In order to achieve sustainability of the surface water capture and of the storage structure, the type of strategic management response farmers undertake when under pressure from their institutional environment to manage dams sustainably warrants critical attention: yet, this has not been addressed in the literature to date.

Chapter 2 has three purposes. Firstly, there is a need to clarify the background issues that are pivotal to the research. The discussion will focus around the fundamentals of farm dam management, and sustainability and sustainable management in this context. In order to illuminate the issues surrounding sustainable farm dam management, discussion will be provided about the problems of equity and safety and the resulting impacts and threats in a cumulative farm dam failure scenario. Secondly, in order to address the first part of the overarching research problem, that is, Research Problem 1, understanding of the equity and safety mechanisms in the institutional environment of farmers managing dams is required. Although this understanding will mostly be provided by the review of the sustainable farm dam management institutional environment in Chapter 3, the farm dam literature in this chapter forms the foundation for criteria for further review. Lastly, as Research Problem 2 requires understanding of the institutional pressures that can cause a sustainable farm dam management response from farmers, this chapter provides foundation for that understanding through background review of institutional theory, resource dependence theory, and their amalgamation in the framework adopted by this study (Oliver, 1991) for further development in Chapter 4. To begin, the fundamentals of

farm dam management will be introduced in the next section to provide context for the problem under investigation by this thesis.

2.2 Fundamentals of farm dam management

Farm dams for the purposes of this research are water storage structures constructed in rural areas for capturing surface water runoff generated from the hills and valleys above them. It is very common to find farm dams in catchments. The undulating topography guides the surface water runoff into small tributaries and streams that are then dammed to capture the water for agricultural and domestic uses. Farm dams are most commonly earth-fill embankments (for a fully comprehensive guide to types and details of farm dam construction see Lewis, 2002) and when constructed in catchments allow farmers to restrict stream flow and surface water runoff downstream until the dam fills and overflows through a spillway. Also referred to as an overflow channel or stream return (DSE, 2007; DPIW, 2008), a spillway is a critical part of dam design as it provides the release of flows from a dam into a downstream area so that the water does not overtop and damage or destroy the dam. Figure 2.1 (a) and (b) demonstrate the severity of an individual farm dam overtopping.

Farmers, as the representatives of farms as organisations, undertake dam management activities which include the planning, controlling and coordinating for water supply via dam construction and maintenance within the bounds of institutional rules and guidelines. The main areas of management activity that relate to ongoing farm dam sustainability include operation and maintenance, continued inspection of dam condition, ongoing consultation by the project consultants after the dam is operational, and regular review of design and operational maintenance procedures (ANCOLD, 2000a; 2000b). Dams are an important physical asset to many farmers because they provide a critical source of water for farming operations therefore, their importance to agriculture is discussed in the following section.

Figure 2.1(a) – A Tasmanian farm dam overtopping during heavy rainfall

(Ditchfield, 2011, pers.comm. 6 February)



Figure 2.1(b) – Ultimate dam wall failure resulting from overtopping – Situ Gintung Dam*

(BBC, 2009)



*As noted in Chapter 1, in 2009 the small rural 10m high Situ Gintung earthen dam in Jakarta, Indonesia failed by overtopping causing the deaths of approximately 100 people (The Associated Press, 2009).

2.2.1 Importance of farm dams for agriculture

Globally, second only to availability of drinking water, agricultural food scarcity is the world's greatest priority (Turral *et al.*, 2011). Agriculture is a critical component of the economy globally and in many countries food requirements have demanded expansion of water capture, storage and use to achieve higher yields (Ayers & Westcot, 1985; de Fraiture *et al.,* 2010). However, the ongoing sustainability of water for agriculture is a global concern (Turral *et al.,* 2011). Dryland agriculture and the growth of crops and watering of stock cannot be undertaken without significant and increasing water supplies (Ayers & Westcot, 1985; NFF, 2012). Agriculture is the single largest user of water resources, using a global average of 70% of all fresh water (Ayers & Westcot, 1985). Internationally in tropical, subtropical and Mediterranean climates, it is often essential for dams to be constructed on streams or to capture runoff in order to facilitate off-season storage of vital water supplies (Stephens, 2010). In Australia, during summer (and often winter) months, the surface water stored in farm dams provides an essential source of water for domestic, stock and irrigation purposes. Farm dams are an especially critical component for dryland agriculture (SKM, 2000; Savadamuthu, 2002; Teoh, 2002) where reliance is solely on rainfall and runoff year-round (Callow & Smettem, 2009). In 2008/2009 in Australia agricultural water use accounted for 54% of total water consumption equating to 7,580 gigalitres of use (ABS, 2009). The highest water consumption is from sheep, beef cattle and grain farming, accounting for 31% of use, followed by other crop growing (27%), dairy cattle farming (18%) and fruit and nut tree growing (15%) (ABS, 2009). The majority of the water used by agriculture in general is self-extracted water (52%) which includes surface runoff and stream flow captured in farm dams (ABS, 2009).

The importance of the financial assets (Lewis, 2002) and water assets (WASB, 2010) contained within farm dams, puts pressure on farmers to store excessive water unfairly in times of drought (Smith, 2001; McKay, 2005; MDBC, 2007; Pisaniello *et al.*, 2011a). This added pressure can ultimately result in unsafe dams in times of flood (Pisaniello and McKay, 2007) because of unsustainable management behaviour (Lewin *et al.,* 2003). McInnes *et al.* (2003) highlight in their study of viticulture, that increased competition for water is detrimental to the industry in times of drought, yet in times of flood when extreme rain events prevail, there is also significant harm to grape growing businesses around Australia. The above highlights the importance of sustainable farm dam management behaviour for agriculture in Australia. Therefore, farm dam management will be placed in the context of sustainability and sustainable management in the next section and three specific management issues will be identified that are fundamental to sustainable farm dams.

2.3 Sustainability and sustainable management

There is little agreement on the meaning of sustainability although there is acceptance that it involves consideration of current and future (1) environmental, (2) social, and (3) economic aspects and the objective of moving toward goal attainment across these three elements. There has been much work on trying to resolve the environmental, social and economic challenges of sustainability over the past forty years (Dyllick & Hockerts, 2002) since the evolution of the concept arising out of an examination of human-environment interaction at the World Commission on Economic Development (UNWCED). The resulting Brundtland Report of 1987 defines development as sustainable if it 'meets the needs of the present without compromising the ability of future generations to meet their own needs' (UNWCED, 1987, p.43). However, for the purpose of this research, the notion of business sustainability is a more focussed and practical advancement of the concept, defined as 'adopting business strategies and activities that meet the needs of the enterprise and its stakeholders today while protecting, sustaining and enhancing the human and natural resources that will be needed for the future' (Deloitte & Touche, 1992). In this context, management of a farm dam in an equitable way to balance the interests of different stakeholders, and in a safe way to protect communities and the environment, is vital for present and future generations.

The concept of sustainability defined above includes elements of risk and uncertainty of current and future environmental, social and economic consequences and their interrelationship (Hockerts, 1999). Management of this risk and uncertainty is highly variable and acknowledgement of the importance of flexibility of objectives of and approaches to sustainable management is essential (Loucks, 2000). Many authors have applied management concepts to understand why managers make an active commitment to environmental and social goals and manage for sustainability. A commitment to sustainability management might be to gain a competitive advantage (Oliver, 1997; Russo & Fouts, 1997), to create reduced costs or increased efficiency (Schaltegger & Mueller, 1997; Schaltegger & Burritt, 2000; Burritt & Schaltegger, 2001), or simply to follow a corporate strategy of sustainability (Bansal & Roth, 2000; Hahn, 2004). Some authors have gone deeper to look at the motives behind sustainability management and the institutional pressures and resource dependencies that drive the behaviour (Hahn, 2004; Bansal & Roth, 2000), recognising that sustainable management requires 'multi-objective tradeoffs in a multidisciplinary and multi-participatory decision-making process' which is particularly true for sustainable *water* management (Loucks, 2000, p.3).

The sustainable management of *farm dams* extends to two main areas: the fair sharing of water and the safety of the storage structure. Firstly, if the water sharing is unfair then there will be unsustainable environmental outcomes that result from the deprivation of critical water resources, unsustainable social outcomes for communities who may ultimately have water sources reduced, and unsustainable economic outcomes for farmers downstream who may have farming operations adversely affected. Secondly, if the water storage is unsafe, then there will be unsustainable environmental outcomes if dam failure causes an indefensible influx of water into a system, unsustainable social outcomes if the dam failure causes loss of life, damage to infrastructure and homes, and unsustainable economic outcomes for the farmer deprived of farming operations and liable for damages to those downstream whose properties or businesses are damaged. Both elements of sustainable farm dam management are critically important but unfair water sharing often leads to an unsafe structure and thus the sustainability of water sharing of farmers and stakeholders who each have distinct interests in precious surface water resources and will each have different sustainability responses is important to understand (Downing *et al.*, 1997). Sustainable regional and global water planning must address questions of environmental, social and economic capital and the equity of how water is shared, for example, for satisfaction of stock and domestic use, irrigation for farming businesses, agricultural community needs, water trade, maintenance of ecological systems and environmental flows and services, for current - and future - generations (Goodland & Daly, 1996; Gleick, 1998; Wheeler *et al*., 2012).

Dyllick and Hockerts (2002) integrate three types of capital and relevant sustainable management criteria to define sustainable organisations. This conceptualisation of the three arms of sustainability (Figure 2.2) has formed the basis of a definition of what sustainable farm dam management is for this research:

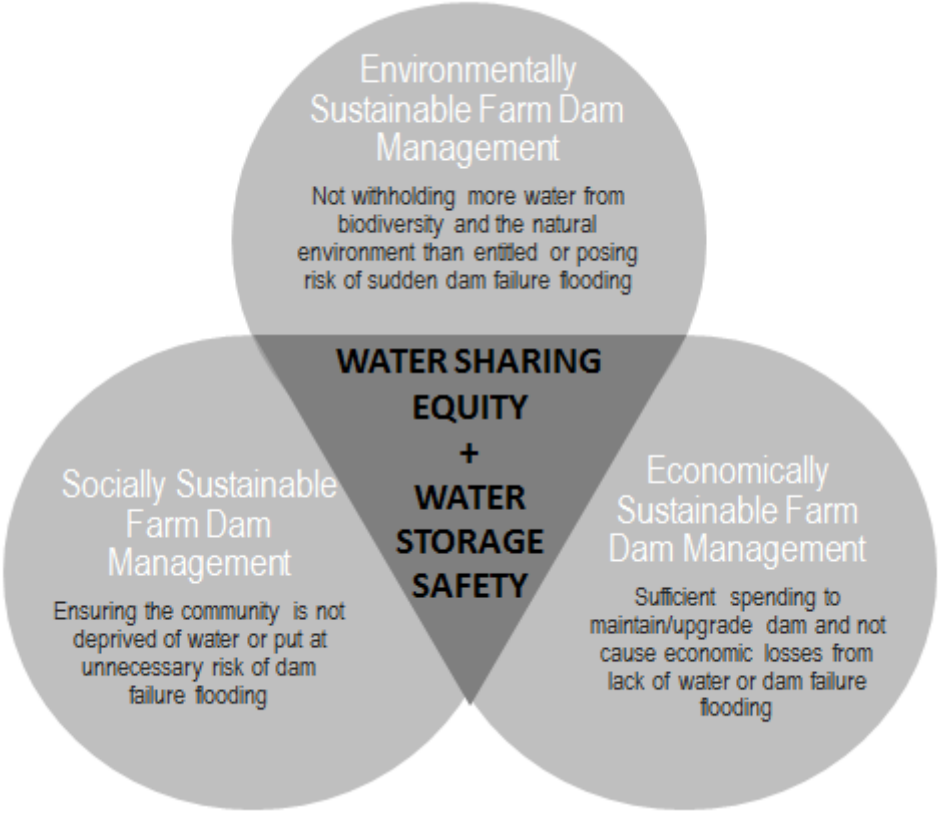
- **Environmentally Sustainable Farm Dam Management** – stores only the amount of water allocated/licensed within a safe structure and does not engage in any farm dam management activity which could degrade the ecosystem downstream either through (i) deprivation of water in times of drought, or (ii) sudden damaging influx of water in times of flood.

- **Socially Sustainable Farm Dam Management** –stores only the amount of water allocated/licensed within a safe structure and does not engage in any farm dam management activity which could (i) deprive downstream communities of sufficient

water for business or survival in times of drought, or (ii) put communities at risk of loss of life or property from dam failure in times of flood.

- **Economically Sustainable Farm Dam Management** – devotes sufficient financial resources to dam maintenance to ensure that water storage does not provide threat to liquidity of the farm and does not undertake any farm dam management activity that could (i) economically disadvantage communities and businesses downstream through deprivation of water entitlements in times of drought, (ii) be of detriment to the liquidity of the farming business through litigation from downstream damage or put communities at risk of economic loss of infrastructure from dam failure in times of flood.

Figure 2.2 – The three arms of sustainability and their overlaps as applicable to this research



Sustainable management and the sustainable management of farm dams is a function of various economic, environmental, ecological, social, and physical goals and thus multi-objective tradeoffs are required (Global Water Partnership, 2000; Slobodan, 1996; Loucks, 2000; Tol, 2005). Sustainable management must also factor in tradeoffs between what we would like to do today for the current environmental, social and economic conditions, but also for future conditions. The challenge for organisations and governments is the

motivation required to make difficult decisions and tradeoffs if sustainable management, especially of water resources is to be achieved (Slobodan, 1996; Muller, 2007). Literature suggests that when researching sustainability management behaviour, it is beneficial to put emphasis on the analysis of representatives of organisations' motivations to explain different approaches (Hahn & Scheermesser, 2006). For example, through institutional theoretical analysis which allows for consideration that organisational representatives, or managers, are likely to sustainably manage to gain legitimacy in their institutional field (Prakash, 1999; 2001; Bansal & Clelland, 2004; also see Section 2.4.1 for full discussion of institutional theory and 2.4.1.2 for legitimacy specifically).

Leading organisations have increasingly recognised the critical need to manage sustainability performance (Epstein, 2008) and there is a definite need for research that focuses on national, regional and community pressures on sustainability management practice (Labuschagne *et al.*, 2004). Research has identified tools for managing for sustainability such as environmental accounting (Schaltegger & Burritt, 2000, for a full review see Schaltegger *et al.,* 2002). Sustainable management of water resources also has multiple tools, for example, 'spatial-scales' approaches to areas of interest (for example, farms, catchments, or basins, Cooper & Bottcher, 1993), water pricing (EEA, 2008), water accounting (WASB, 2010), and meeting water management sustainability indices and guidelines (Loucks, 2000), and Integrated Water Resources Management (IWRM) that seeks to identify and then to achieve tradeoffs between different water management objectives, including environmental sustainability, economic efficiency and social equity, all of which have implications for equitable water sharing and disaster mitigation (Global Water Partnership, 2000; Tol, 2005; Muller, 2007). However, for the purpose of this research, managing sustainably is applied to the management of agricultural surface water *storage* rather than application of broader sustainability management tools. This research applies institutional and resource dependence theories to the particular issue of sustainable *farm dam* management, gaining perceptions of managers (farmers) as representatives of organisations (farms), in order to fill the gap in the understanding of their sustainable farm dam managerial decision making and motivation (Welcomer *et al.,* 2003; O'Dwyer, 2002). The following section highlights the three unsustainable farm dam management practices central to this research which can result in threats to environmental, social and economic sustainability.

2.3.1 Critical unsustainable farm dam management practices

Unsustainable farm dam management practices that could be motivated by capturing a critical and scarce resource include farmers (i) building additional dams without a license to

endeavour to store more water than entitled to, (ii) increasing storage capacity through increases in wall height without a license, or (iii) under-designing, neglecting, or modifying a spillway to increase storage capacity. This research has focus on (iii) because a dam's spillway is a critical component of farm dam infrastructure and if it is not managed well there can be disastrous consequences for communities and the environment downstream (Pisaniello, 1997; DPIW, 2008; Pisaniello & McKay, 2007; Stephens, 2010). The spillway is the area of the dam where the effects of drought and flood are directly implicated and exacerbated by climate extremes (see Pisaniello *et al.,* 2011a). The three critical management issues relating to spillways are as follows:

- **Unsustainable farm dam management practice 1: Inadequate spillway design and or construction**

  In order to avoid costs and inconvenience, many farm dams, which may have been improperly designed and/or constructed initially many years ago, are not reviewed and maintained to current flood capability design standards (Pisaniello & McKay, 2007; Pisaniello, 2009; 2010). Dams must allow for water to travel easily out of the structure once the capacity of the reservoir is reached. Hence, spillways should be designed and constructed to current best practice engineering standards. These standards will allow heavy runoff from flood events to pass through the reservoir safely without compromising the dam structure itself, thereby reducing the impact on downstream communities (ANCOLD, 2011a). Inadequate spillway flood capability is a common problem because of the continuous and rapid advancements in meteorology and hydrology. These advancements consistently result in more up to date maximum probable rainfalls and design flood standards which are increased from when the dam was originally constructed (Pisaniello & McKay, 2007). Spillways are also often constructed by contractors that lack the technical skills for adequate farm dam construction (see Pisaniello & McKay, 2007). In addition, spillways may be purposefully under-designed and/or built smaller than necessary in order for the embankment to capture more storage (Tingey-Holyoak *et al.*, 2011).

- **Unsustainable farm dam management practice 2: Inadequate spillway maintenance**

  In addition to poor design, many farmers do not see the removal of debris and natural spillway blockages as a critical part of their management and deliberately or neglectfully do not maintain their spillway. Many farmers allow trees and vegetation to grow out of the spillway which increases the likelihood of dam

leakage and failure by 'piping' around tree roots (Lewis, 2002). Accumulated vegetation in the spillway also restricts its capacity to safely pass overflows without overtopping the dam wall. Any overtopping will scour and undercut the dam wall which reduces embankment strength and increase the likelihood of a dam burst (Pisaniello, 1997; Lewis, 2002; Pisaniello & McKay, 2007; Pisaniello, 2009; Pisaniello *et al.,* 2011b). Also, in many cases, it is assumed that heavy downpours will be clean water runoff into the dam which is a faulty assumption and the debris from even minor floods can further block a spillway (Rundqvist, 2005). The debris and vegetation within the spillway also allows farmers to unfairly store more water than they are entitled to, even though this may not be the intention.

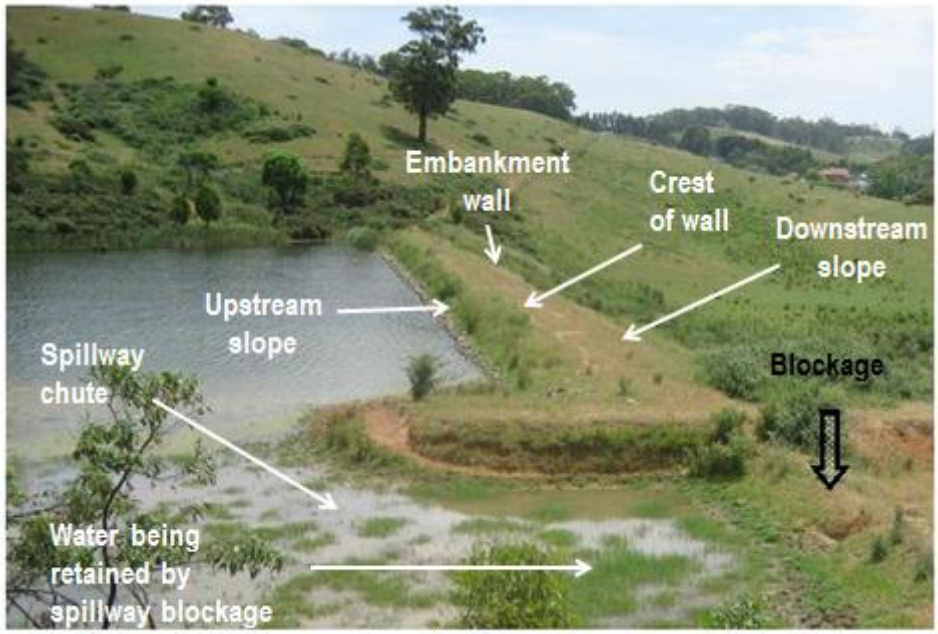
- **Unsustainable farm dam management practice 3: Deliberate spillway blocking**

  A particular on-farm water storage management practice that is unsustainable is deliberate spillway blocking. By blocking spillways farmers are able to store significant amounts of potentially non-entitled water; significant because small increases in storage height at the top end of the reservoir (which has a triangular prism-like geometry) results in large increases in storage volume (Pisaniello, 1997; McMurray, 2004). Purposefully blocked spillways using obstructions such as sandbags, mounds of soil, timber sleepers and concrete slabs, severely diminish dam capability to safely withstand floods (Pisaniello *et al.,* 2011b). Figure 2.3 (a) demonstrates the basic features of earth-filled catchment farm dams and Figure 2.3 (a) and (b) both highlight the problem of deliberate spillway blocking in the form of a mound of soil and concrete sleeper obstruction respectively.

Figure 2.3 - Features of a typical earth-filled catchment dam and deliberate spillway blocking examples

(a) A South Australian farm dam with a mound of soil blocking the spillway and also highlighting other features typical of catchment dams

(Pisaniello *et al*., 2012)



(b) A Tasmanian farm dam blocked with concrete sleepers

(Pisaniello *et al.,* 2012)



Recent field research by Pisaniello *et al.* (2012) finds cases of unsustainable farm dam management problems 1, 2 and 3. Using a ground-based photographic-interpretation method, the authors found the problem to be widespread throughout Australia with 70.4% of spillways blocked in South Australia, 48.8% in New South Wales, 62.3% in Victoria, and 36.3% in Tasmania (Pisaniello *et al.*, 2012). The ultimate consequence of these three main unsustainable farm dam management practices is an unsustainable farm dam structure (Figure 2.4) whereby: (i) downstream communities and the environment are possibly not getting their full water entitlements from the catchment upstream because overflow is restricted, and (ii) communities and environments are also ultimately placed at unacceptable risk from an individual unsafe farm dam structure because of pressure on the embankment wall.

Figure 2.4 - The fundamental unsustainable dam management practice addressed by this research



Importantly, the three unsustainable farm dam management practices create an overall unsustainable situation that can accumulate within a catchment, especially in a climate of extremes. This is the focus of the following section.

2.3.2 Cumulative impacts and threats arising from unsustainable farm dam management in a dual extreme climate

On the individual level, unsustainable farm dam management can result in unfair and unsafe surface water storage. However, multiple inequitable and unsafe individual farm dams in a catchment can lead to (1) increasing reduction of water flow during droughts, and (2) cascade and/or cumulative failure during floods - both situations with catastrophic downstream consequences. Hence, this climate dual extreme exacerbates the negative consequence of unfair water sharing in times of drought, but also the risk of disastrous cumulative dam failure in times of flood, especially in the catchments of large public dams.

These two extremes and their impact/threat in a cumulative scenario will be discussed further in the following sections.

2.3.2.1 Cumulative impact/threat climate extreme 1: Drought

The very nature of farm dams means a reduction of the total quantity of water available to other farmers and community members and the downstream environment. The environments deprived are water-dependent ecosystems and habitats of plants and animals ranging in size from micro-organisms and invertebrates to larger species (McMurray, 2007). This impact is greater when the dam is a large dam, such as a public dam or, more commonly, when many small dams create a cumulative barrier effect (Pisaniello *et al.*, 2011b). It is acknowledged that many farm dams are quite small and designed for stock and domestic use, however 'many small dams can add up to a lot of interception' (Young & McColl, 2009, p.31). Because the cumulative effect of farm dams means the first significant rains are taken before reaching lower order streams, the magnitude of flows is progressively reduced (NWC, 2005). Farm dams 'tend to capture every drop of water that reaches them until the dam is full' (Young & McColl, 2009, p.31) and then flows occur through the spillway (Lewis, 2002). So when many farm dams have inadequate spillway capability, either by design (unsustainable practice 1) or blockage (unsustainable practice 2 and/or 3), even more water is withheld from the system causing potentially catastrophic deprivation of water downstream in times of drought. Farming and other businesses downstream can suffer greatly as can communities, particularly if unsustainable farm dam management exists in catchments above large public dams that provide drinking water.

In Australia, there has not only been a 'suite of misentitlement and over-allocation problems' (Young & McColl, 2009, p.34) but also unintentional and/or deliberate blocking of spillways which dramatically exacerbates the problem of unsustainable unfair water sharing (Pisaniello & McKay, 2007; Pisaniello *et al.* 2011a). Each farm dam reduces surface water yields in catchments dramatically, similar in scale to a plantation forest with inflows and evaporation losses unmetered (see Young & McColl, 2009). Poor management, failure to define water entitlements and allocations, and inadequate water accounting systems are all factors that result in farm dams cumulatively depriving downstream users of water (Bennett, 2010). Dams, by their very nature, disrupt physiochemical and biological process and the conditions to which ecosystems have adapted (McCartney & Sally, 2007). But ecosystems are further impacted by reduced flows of surface water that exist in times of drought that result in ecologically significant negative effects on environments downstream. Negative effects are further compounded by the

cumulative effect of riparian land management and the related aggregate effect of flow fluctuations caused by reservoirs and dams (Hillman, 2008). Microinvertibrates, fish, and bird migration and breeding are all negatively impacted, in addition to natural vegetation (Hillman, 2008). This link between ecology and the direct cumulative impact from upstream diversions requires urgent attention, as does the deprivation of water for public and business users downstream.

2.3.2.2 Cumulative impact/threat climate extreme 2: Flood

Exacerbation of flood impact/threat caused by unsafe dams normally carries a relatively low probability since extreme flood events that cause dams to fail are in the domain of 1-in-100 years. However, if farm dams are not appropriately managed, the probability of impacts and threats will increase. The impact on downstream communities and the environment can be extremely high, especially in the cumulative failure scenario discussed further below.

ANCOLD specify guidelines for categorising dams based on the hazard to the downstream community and environment if the dam failed. The higher the hazard category, the higher the level of attention needs to be paid to the dam on an individual basis to assure the risk to the downstream community in the event of flood is acceptable (ANCOLD, 2003). However, ANCOLD also acknowledges that if small dams are located upstream they have the potential to cause cascade failure of larger more hazardous dams, warning 'the combined effect of multiple dam failures should be the basis of the hazard category of the upper dams' (ANCOLD, 2000b, p.10). This supports the notion that the cascade/cumulative overflowing of inadequate farm dams intensifies the surge of water flowing downstream (Pisaniello, 2009; ANCOLD, 2000b; Pisaniello *et al.,* 2011b).

When many farm dams spill water over their banks, tides cause flood events to be magnified. For example, a 1-in-100 year rainfall event can become a 1-in-10,000 year flood event. A study of the Kangaroo Creek Dam (LDC and SMEC, 1995), one of South Australia's largest water supply dams, found the peak inflow would increase fourfold if all small dams in the catchment failed at the same time in a 1-in-200 years flood event. This exacerbated flow resulting from the farm dam failures would exceed the public dam's spillway capability, which should otherwise be able to pass at least a 1-in-10,000 years flood event, putting downstream communities and the environment at unacceptable risk (Kazarovski, 1996) (see Chapter 1 for a history of dam failures internationally and in Australia).

These cumulative impacts/threats in a dual extreme environment may be further intensified by the effects of climate change. In areas of middle and higher latitudes, continuing and increasing variability in temperatures and evaporation are predicted to be exacerbated (UNIPCC, 2007a). Increasing dramatic variability in rainfall will have a significant impact on water resources: importantly, stream flow will decline further in times of drought (van Dijk *et al.*, 2006), and the impact of heavy rains will be increased (UNIPCC, 2007a). Hence, the effects of climate change may further intensify the problem of inequitable and unsafe water storage. A discussion of the effects of climate variability, exacerbated by climate change, on agricultural water storage is therefore warranted as follows.

2.3.3 Exacerbation of the cumulative impact/threat of farm dams through climate change

Around the world, the impacts of climate change on the hydrological cycle are being witnessed. Agriculture as a primary user of surface water from rainfall is experiencing change in how it must manage irrigated and rainfed systems (Turral *et al.*, 2011). Climate change will impact upon agricultural production at the global level, including both developed and developing countries (Crosson, 1997). Over recent decades, steadily rising temperatures have already exacerbated the effects of drought on agriculture (Jones & Durack, 2005). Drought has prevailed in Australia for more than ten years from 1997-2009 and temperate southeastern Australia is the region that is the hardest hit by this lack of rainfall (Fitzsimmons & Barrows, 2010). Australia's dramatic climate variability gives rise to extreme fluctuations in surface water runoff and streamflow. It is predicted that streamflows will decline by up to 20% by 2030 and up to 45% by 2070 which will result in increased competition for water which is a critical concern in areas like the Murray-Darling basin which is a major source of runoff for southern Australia and supports many agricultural industries (Kingwell, 2006). As drought frequency has increased in severity it has been married with an increase in farm dams in the south east of the country by up to 48% (van Dijk *et al.,* 2006). When effects of agricultural storage of runoff are exacerbated by climate change, farm dams have been identified as the most critical contributing factor to reduced water availability over the long term (Productivity Commission, 2006; van Dijk *et al.,* 2006).

The increase in climate variability will also bring an increase in heavy rainfall and floods (UNIPCC, 2007b). In Australia, it has been forecast that there will be increases in both the frequency and intensity of heavy precipitation (UNIPCC, 2007b). Although the Atmosphere-Ocean General Circulation Models from the recent Intergovernmental Panel on Climate Change assessment (UNIPCC, 2007b) are on a large spatial scale and inappropriate for addressing problems at the catchment level (Christensen *et al.,* 2007), more fine point climatic modelling is beyond the scope of this research (for applicable

extreme value climate statistical techniques and modelling applicable to hydrological phenomena see Katz *et al.,* 2002; Kharin and Zwiers, 2005; Kharin *et al.*, 2007; Towler, 2010). This study operates at the level of consensus that the increases in precipitation are likely to result in increases in flood frequency and magnitude and that any beneficial effects from this increase in precipitation in areas prone to drought will be tempered by the adverse effects of unpredictable flooding (Kundzewicz *et al.,* 2008).

For Australia, increases in flood frequency and magnitude will have negative effects on agriculture (Pittock, 2003a; 2003b). Heavy floods will not only negatively impact soil and crops but critically increase vulnerability of all agricultural infrastructure to damage, particularly dams and weirs (Smit *et al.*, 1999). Farm dam management becomes increasingly challenging under climate change pressure. In the review phase of management, existing dam spillways designed for present conditions may be found to be inadequate. Muzik's (2001) study in Canada found that for thousands of farm dams, the spillways would not have sufficient capacity to pass increased flows predicted under climate scenarios of global warming in the 1.0-3.5 degrees Celsius range within the next 100 years and accompanying significant changes in rainfall. The other problem is in the maintenance and controlling phases of management when increased water insecurity and variability puts pressure on farmers in an already stressed system, to undertake alternative action when rainfall for crops or grazing is unreliable.

With the knowledge of sustainable farm dam management, the problems of dual-extreme impacts and threats, only exacerbated further by climate change, the following section now places the central problem of sustainable farm dam management in its institutional setting, in order to provide the theoretical background of the study.

2.4 Sustainable dam management response to institutional pressures

Institutional theorising has been influential in research into farming and agriculture (Ruttan & Hayami, 1984; Carroll *et al.*, 1988; Michelsen, 2000; Lynggaard, 2002; Jack, 2005; Ransom, 2007). Similarly, the theoretical approach has been applied to water management (Brown, 2005, Rayner *et al.*, 2005) and sustainability management research more broadly (Jennings & Zandbergen, 1995; Hoffman, 1999; 2001a; 2001b; Delmas & Toffel, 2004). When applied as pressure to a farmer (organisation representative) within a farming business (organisation), in a regional and possible industry cluster of farms sharing a water resource (institutional field), as part of a complex array of regulatory, industry, financial and community and demands (institutional environment), institutional theory allows for

understanding of how the pressures and power of institutions act on the farmer to manage their dams in a sustainable way.

This research applies theoretical constructs to the representative (farmer) of the organisation (farm). The focus is on the perceptions of the individual farmer as manager because they serve to represent the organisation (farm) by carrying out the specific farm dam management activity addressed by this research. Rather than focusing broadly at the organisational level, or even a field as the unit of analysis (see Davis & Marquis, 2005), this approach facilitates understanding the strategic motivations of the farmer. As the representative of the organisation, the farmer responds to institutional pressure which guides internalisation and reproduction of behaviour at the individual level (Veblen, 1909). This approach is particularly relevant in agriculture where very often the farmer is a sole worker or part of a very small 'organisation' or farm with few other employees[3].

The behaviour of individual farmers is largely a result of the 'institutional milieu into which they are born' therefore, understanding the detailed nature or structure of that institutional environment is critically important for empirical testing (Dugger, 1979, p.902). Acting on behalf of an organisation, or farm, the farmers' '..norms, habits, and unconscious conformity to traditions account for institutionalized activities' within their field (Oliver, 1997, p.700; Berger & Luckmann, 1967). As the farmers' institutional field becomes more complex, the demands and pressures for them to respond with a certain management practice increase (Scott & Meyer, 1987, and more recently, Hoffman, 2001a; 2001b). Such as for farmers who can be faced with varying and increasing pressures to manage farm dams sustainably from within a convoluted institutional field. Consistent regulatory pressures, and shifts and changes are handed down by government as part of a broader institutional make-up that includes the farmers' local farming community, the applicable farming industry bodies, insurers, banks, community groups, environmental groups, and even the media, which need to be understood by the farmer as a manager (Hoffman, 2001a).

Institutional theory allows for understanding that even if pressure to act in sustainable ways comes from the field level, often the actual actions of a manager, or in this case the farmer, to manage in a sustainable way, will reflect internal interests, such as lower insurance premiums, keeping neighbours and other business satisfied, and competitive strategy (Hoffman, 2001a). Ultimately, whether the sustainability management response is cultivated by overt coercive pressure, through command and control regulation, or by

[3] There are approximately 134,000 farm businesses in Australia, 99% of which are family-owned and operated (NFF, 2012).

normative pressure through industry groups, the response generated is likely to be a reflection of the power of dominant institutions in the field (DiMaggio & Powell, 1983; Hoffman, 2001a).

However, the members of the institutional field must continuously place pressure on the organisation to have any profound effect on changes in practice. Specific 'actors' (individuals, groups, and organisations created by 'persons and states', Meyer, 2008, p.798) will usually lead sustainable practice shifts and individuals emerge who then influence norms, and guide others in the best way to act (Hoffman, 2001a). Often groups of organisations will act in a similar way indicating how susceptible they are to the social influence of external actors (Hoffman, 2001a). However, there also needs to be consideration that often an institutional shift can occur in response to an initiating event or trigger (Hoffman, 1999). Whilst such events can take many forms (for example, milestones (Hannigan, 1995) or discontinuities (Lorange *et al.*, 1986)) the most common form in the farm dam management setting would be a catastrophe (see also Hannigan, 1995 for analogous situations, for example oil spills, toxic fires, etc.) that invariably impact dramatically on the organisation at all levels.

Like Institutional theory, resource dependence theory has been applied to selected farming and agricultural studies (Ganz, 2000; Fazzi, 2010). In addition, the theory has been successfully used for the analysis of sustainability management (Sharma & Henriques, 2005) and water management projects (Gafsi & Brossier, 1997). The application to this study allows for attention to the response of managers through the focus on the principles associated with the acquisition, storage and sharing of a scarce resource from the environment. Even for a highly experienced farming business the acquisition and storage of surface water can be problematic with rainfall uncertain and often unpredictable. Hence, in times of water stress, managers can respond in different ways to constraint (Pfeffer & Salancik, 1978). A resource dependence perspective allows for understanding of the problems the farmer faces with managing surface water resources and the response to the environment and the constraints specific to its field. Farmers do not have ultimate discretion on how they manage their farm dams in most situations; there are various pressures throughout their institutional fields. However, through the lens of resource dependence theory, farmers *do* have some discretion over how to structure their activities to respond to the uncertainty created by interdependencies (Pfeffer & Salancik, 1978).

Institutional theory and resource dependence theory are both focused on the relationship between organisational actors and pressure from the environment (Oliver, 1991). This research requires comprehension of multiple conflicting external pressures that constrain

organisational choice and motivations for legitimacy, thus using the two theories gives the analysis more power (Sherer & Lee, 2002). The following sections detail the main concepts and developments of the two theories ultimately in order to integrate the two sets of literature into understanding of possible resource dependence strategic responses to institutional pressures which are developed as testable hypotheses in Chapter 4 based on Oliver's (1991) strategic response typology, tailored for the sustainable dam management arena.

2.4.1 Institutional theory

When considering institutional theory, a central tenet is the nature of the institutional environment and organisations' desire for legitimacy within that environment. Discussion will commence with early developments of institutional theory, and conclude with critiques of the theoretical concepts that appear in the literature.

2.4.1.1 Early theoretical developments

The development of institutional theory to the current form commonly applied in organisational science today, possibly dates back to when Philip Selznick conveyed his views that organisations were made up of the characteristics of their actors and subject to constraints and pressures from external forces (Selznick, 1957). This formed the basis of much of the popular institutional theorising. With almost predictive capability of the future work on institutionalisation, Selznick (1957) drew a line between purely technical and mechanical type organisations (that get the job done), and organisations that had become institutionalised and were less easily dispensable (that act to adapt to external pressures). This allowed Selznick (1957), and the authors that followed, to view institutionalisation as a process that happens over time and also comprehend the differences in organisations that make them more or less subject to the forces that cause institutionalisation. Selznick (1957), whilst paving the way in defining institutionalisation, did not go so far as to describe exactly how the process occurred.

The next iterations of institutional theory and institutional pressures, that are the focus of this thesis, then set the foundation for understanding the processes of institutionalisation: Peter Berger in co-authored work with Luckmann (1967) had a central question of the nature of origin of social order that allowed for development of the concept of 'shared reality' in social interaction. This notion then formed the basis of Zucker's (1977) pivotal experimental research. This later work laid claim that traditional approaches to institutionalisation (that is, of the Selznick variety) did not provide an adequate explanation of cultural persistence thereby identifying a need for an ethnomethodological approach to

institutionalisation. Zucker's (1977) new approach allowed for creation, testing and ultimately, support of, three levels of institutionalisation: (1) generational uniformity of cultural understandings, (2) maintenance of understandings, and (3) resistance of these understandings to change. This work therefore advanced Selznick's (1957, p.728) ideas by identifying that institutionalisation has both 'process' and 'property' characteristics. This means that whilst the process of resisting institutional pressures, such as those to manage sustainably, is socially defined, the process is also a taken for granted part of an organisation's environment. Ultimately, these three levels of institutionalisation have formed the basis of most modern institutional theorising.

In conjunction with the aforementioned notions of the social construction of reality, Meyer and Rowan in their 1977 seminal piece, also viewed institutionalisation as a social process whereby an organisation accepts the taken for granted way activities are undertaken. The authors termed the behaviours that result as a part of the process of institutionalisation as 'rational myths'. This important advancement of institutional theory made it conceivable that organisations, such as farms, respond to institutional pressure because of myths in an environment, rather than because those myths are necessarily connected to more effective organisational outcomes. Meyer and Rowan's (1977) work meant that it was now possible for institutional theorists to cognise that organisations are driven to adopt practices or routines in order to achieve legitimacy for increases in their survival prospects, rather than just for efficiencies.

It should be noted here that this persistent absence of an internal focus for resource efficiency explains the dual framework adopted by this research (Oliver; 1991; see Section 2.6). This notion has interesting application to this empirical study which raises the question of how farmers respond to pressure to sustainably manage farm dams for increased legitimacy rather than increased efficiency of water acquisition and storage. The concept of legitimacy was expanded empirically by Tolbert and Zucker's (1983) seminal set of field studies that examined the diffusion of civil service reforms through municipal governments from 1880 to 1935. This study was the first that allowed for close consideration of how organisations will respond differently to institutional pressures over time. Those with self-interested characteristics were the first to be subject to institutional forces, and later adopters were shown to be responding to pressures in reaction to the perceived legitimacy created by the organisations that were first-movers (Tolbert and Zucker, 1983). The next section discusses the institutional theoretical concept of legitimacy further as it relates to the institutional environment.

2.4.1.2 The institutional environment and legitimacy

A critical concept for institutional theory is the notion of the institutional environment (Hirsch, 1975). The institutional environment is made up of the fundamental political, social and legal rules and norms that form the basis for production, exchange and distribution of resources (Davis & North, 1971; Oliver, 1997). Organisations interact with elements of their institutional environment whenever decisions must be made about issues concerning both the organisation and the surrounding community (Parsons, 1956; Dill, 1958; Thompson, 1967; Evan, 1966; 1972). Examples include rules governing management behaviour, property rights, or rights to governance of resources, such as water (Davis & North, 1971). The key actors are usually state agencies or professional and community bodies (Oliver, 1997). This is distinct from the task or technical environment where organisations are rewarded for their efficient and effective control of resources in the market place by key actors who are resource exchange partners (Scott & Meyer, 1987; Oliver, 1997). Farmers are exposed to pressures from both the institutional and task environments however the institutional environment is the setting that is explored by this research (see Chapter 3). Nevertheless, the way farmers respond to each type of environment is important to note as resource dependence theorists have tended to emphasise the task environment (Oliver, 1997) which will be discussed in Section 2.4.2.1.

Seeking legitimacy is a critical motivation for organisations conforming to survive under institutional theory (Meyer & Rowan, 1977; DiMaggio & Powell, 1983). Legitimacy can be defined as the 'generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions' (Suchman, 1995, p.574). Weber was seminal in drawing attention to the social legitimacy aspects of life, viewing exemplary actions as creating legitimacy (Weber, 1924). In turn, organisations were legitimate if they conformed to standard frameworks for operating. Farmers too require more than just resources and technical and mechanical skill to succeed in their institutional environment: without legitimacy they have little social acceptability and can fail more easily. Resource dependence theorists also emphasise the consistency of organisational goals with social functioning (Pfeffer & Salancik, 1978), however, they stress the importance of coping with problematic interdependencies and actively managing resources (Oliver, 1991). When considered with a resource dependence perspective, legitimacy can be viewed as just another resource. However legitimacy is different from other resources in that it is not material nor can it be 'possessed or exchanged' (Scott, 2001, p.59). Rather, legitimacy reflects alignment with regulation, or community norms.

Despite the rising notion of legitimacy, later institutional theorising has suggested that everything that happens in response to pressures is not necessarily the result of a conscious decision, such as that to legitimise activities, but largely because of the effect of the institutional environment (Meyer & Scott, 1983; March & Olsen, 1984; Scott & Meyer, 1987). Inherently, the argument is advanced that organisations that are operating in more multifaceted and demanding settings will have more complexity in their institutional environments (Scott & Meyer, 1987), such as for agriculture facing increasing cycles of water uncertainty. Thus, the institutional and task environment distinction becomes less important than the comparison of the way the theories predict organisations will respond to pressures.

A critical contributor to the development of the notion of institutional environments, and possibly the most popular work of institutional theorising, is the work of DiMaggio and Powell (1983). The authors used Weber's thesis that rational order had been converted through the power of bureaucracy to an 'iron cage' that had locked up humanity, to show that in the face of growing bureaucracy, organisations were becoming increasingly homogeneous. The focus within the institutional 'field' is a category of horizontally or vertically interlocked organisations that are exposed to the same pressures (DiMaggio & Powell, 1983). The concept of institutional 'logics' signifies the practices and norms that dominate within the institutional field. This is a particularly important notion for this research as the 'logic' of dam management practices in the farmer's field will be regionally specific depending on rules, norms and behaviours that govern the field, such as farm dam regulations and regional practices.

Scott (1994) identifies several dimensions to logics within a field including, content, penetration, linkage and exclusiveness. 'Content' is the most important because if rules and norms are not understood by farmers then the behaviour does not become institutionalised (Friedland & Alford, 1991). This is followed by 'penetration' which identifies the social purposes and management techniques around which a behaviour becomes a norm (DiMaggio, 1991). 'Linkage' refers to the connection of the field logic to other norms and practices within the field (Krasner, 1983) whilst 'exclusiveness' denotes the dominant, or central logics and beliefs that tend to exist in a field (Scott, 2001).

Within the institutional field, governance structures have become paramount in recent theorising. Fligstein (1990) defines 'conceptions of control' where organisations in a field have collective views on how they can resolve competition in the face of other institutional pressures. This combination of control and institutional pressures results in perceptions of governance and how organisational actors interact strategically with regulatory and other

institutional actors (Fligstein, 1990). Farmers will work out their competitive strategies in response to each other but will do this within a broader regulatory setting which will differ in scope for each field.

Despite notions of a field and logics and governance within that field, elements of agency have only recently flowed through institutional theorising, giving focus to the way in which individual actors can act strategically in the face of institutional pressure (DiMaggio, 1988; Oliver, 1991; Christensen *et al.*, 1997). Previously much attention was given to the way organisations were constrained by institutions as structures, not with much involvement from individuals (Meyer & Rowan, 1977; DiMaggio & Powell, 1983). The notion of agency, or of individual farmers having some control over their responses to institutional pressures, is essential to understanding individual management action, often which drives strategy and response. This research actively embraces the notion of agency in so far as managers will be proactive in institutional processes, but not so far that any notion of social structuration of agency will be furthered (see Giddens, 1984). This research takes a simple view, similar to March and Olsen (1984), by acknowledging that there will be more than one rule or pressure placed on a farmer and there will be demands on the farmer to choose a course of action, or strategy, in response to rules or pressures.

2.4.1.3 The three isomorphisms and pillars

The focus of pressure on organisational actors led to possibly the most critical contribution of DiMaggio and Powell (1983) which was their seminal definitions of the three ways organisations become more similar through coercive, normative and mimetic isomorphism. Although isomorphism was originally defined earlier for organisations by Hawley (1968), DiMaggio and Powell (1983) originally modelled the three mechanisms for inducing isomorphism. The three types tend to intermingle in their effect but derive from different conditions and can therefore be considered separately (DiMaggio & Powell, 1983). This work then formed the basis for advancement of the pressures that underlie institutional order by Scott (1995; 2005) who termed the elements, or pillars, regulative (rule-setting, monitoring), normative (prescriptive to social life) and cultural-cognitive (shared conceptions that frame reality). The regulative pillar contains both explicit, formal mechanisms (for example, sustainable farm dam management policy) and implicit, informal mechanisms (for example, legal action from a neighbour). If parallels are to be drawn to DiMaggio and Powell's (1983) typology then this would be coercion with the existence of rules and authority that 'supports and constrains the exercise of power' (Scott, 2001, p.53, see also Scott, 1987). The normative pillar contains standards of behaviour or values and norms that organisations are obligated to adhere to in order to achieve often morally

derived goals (Stinchcombe, 1997) in the appropriate way (Scott, 2001). Social 'fitness' originates within this pillar where organisations adopt a form regarded as legitimate in order to survive in their environment (DiMaggio & Powell, 1983; Scott, 1995). Social 'fitness' and the subsequent 'social licence' to operate (Scott, 2001), are of particular relevance here as normative systems mould and shape social action, such as the undertaking of certain farm dam management practices in order to 'fit in' with the dominant practice of the field. Normative systems also give rights and privileges, such as the undertaking of certain management practices in order to gain access to less expensive insurance. The cultural-cognitive pillar of institutions is where organisational actors attach meaning to a behaviour or practice. The meaning is of course cognitive, inside the actor's interpretation and perception of it, but 'shaped by external cultural frameworks' (Scott, 2001, p.57).

Institutional theorists have emphasized widely how actors in organisations are impacted by wider belief systems, external to the organisation itself (Meyer & Rowan, 1977; DiMaggio & Powell, 1983). All three pillars are of importance, but regulatory mechanisms have unsurprisingly received substantially more attention from scholars than the cultural or normative components (Scott, 2008). Although there is significantly building literature to say that the cognitive and normative features are critical for organisational structures and change, regulation is of interest in areas of sustainability and, importantly for institutional theorists, is able to be manipulated or decoupled from (Evans, 2004) and responded to strategically in a spectrum of ways (Oliver, 1991).

Another feature of institutional theory, that inherently underpins concepts of legitimacy, isomorphism and pillars within an institutional field, is the notion of power. Institutional theory is important in explaining choice in organisations where self-interested actors cannot exert sufficient influence over pressures in their environment because of their relative power within a field (Carpenter & Feroz, 2001). This notion arose implicitly in DiMaggio and Powell's (1983) popular piece where the concept of institutional isomorphism relates to organisational competition for power, social fitness, and institutional legitimacy and is a tool for understanding the politics that infiltrate organisations.

Levy and Scully (2007) highlight how previous institutional theorists have sought to understand organisational behaviours, non-attributable to market pressures and the meeting of expectations that are not associated with technical performance requirements (Greenwood & Hinings, 1996). Levy and Scully (2007) further that institutions endure because these models become 'taken-for-granted' through repeated use, however, the authors also highlight that activities can become legitimate because of the support or

promotion by other powerful constituents (Clemens & Cook, 1999). Clemens and Cook (1999) maintain that at the core of institutional theory is a structural theory of power that sees institutions reproduce themselves by construction of individual actor's roles and routines (see also DiMaggio & Powell, 1991). It is important to note that there has been concern expressed over excessive focus on rational myths and social norms, at the expense of power and self-interest (Perrow, 1985; Barley & Tolbert, 1997). An important contributor to this debate is Christine Oliver (1991) who identified a lack of attention to organisational self-interest and 'active agency', which resulted in development of the dual theoretical framework employed by this study (see Section 2.4.3 and also Chapter 4 for the full model).

2.4.1.4 Critiques of institutional theory

Critiques of institutional theory maintain that the focus on the similarities between organisations results in neglect of the *processes* that cause the parallels to happen (Hirsch, 1997; Hirsch & Lounsbury, 1997; Kraatz & Zajac, 1996; Suddaby, 2010). Whilst these may be valid of earlier institutional work (see Fligstein, 1990; and DiMaggio; 1991), later work has empirically investigated the more complex notion of a field moving through stages (Hoffman, 2001a; Scott, 2001). However, recent thinking suggests that the field must 'be seen instead as a highly complex collective of actors whose composite influence on corporate behaviour is varied and diverse' (Hoffman, 2001a, p.202). There are calls for acknowledgement of organisations as interpretive systems, that is, with collective attachment to meaning to events that infuse organisational processes and outcomes (Suddaby, 2010).

This research has attempted to explore more fully the interpretive capacities of farmers and the possibility that they are 'much more significant managers of symbolic resources' than previously considered by institutional theory (Brignall & Modell, 2000; Suddaby, 2010, p.18). By expanding the research to include resource dependence theory to explore strategic management responses to institutional pressure to create field level change, the study is able to overcome limitations of institutional theory. In addition, when combined with resource dependence theorising, discussed further in the next sections, institutional theory allows for a 'launching pad' to conceptualise the strategic sustainability management response of farmers to pressures from their institutional environment.

2.4.2 Resource dependence theory

Like institutional theory, one of the most influential theories in organisational and strategic management theorising, resource dependence theory, also has a focus on the subjectivity

of organisations to external pressures. However, resource dependence theory assumes that actors will take action to manage uncertainty. The seminal authors, Pfeffer and Salancik (1978), define the principle arguments underpinning the framework of resource dependence theory as: (1) the units for understanding organisational relationships and society are organisations, (2) these organisations are constrained by their interdependencies with other organisations, (3) interdependency and environmental uncertainty results in distress about future survival, (4) there are actions to manage interdependencies but all are not successful so there is always residual uncertainty and new patterns of interdependence forming, and (5) the patterns of dependence produce interorganisational power that effects organisational behaviour (Pfeffer, 1987). To reduce uncertainty and resource dependence pressures, organisations will bypass sources of constraint on resources, cultivate alternative supply sources or form alliances and coalitions that can act *together* with regard to the resource in question (Casciaro & Piskorski, 2005). Organisations will pursue various tactics, or responses, to pressures that achieve the uncertainty reduction in question (Hillman *et al.,* 2009). For example, through co-optation, farmers that are competing for a scarce surface water resource can stabilise security of water sharing and fair storage through creating social relationships and exchanging friendship, status or information (Casciaro & Piskorski, 2005). The usefulness of resource dependence theory for both economics, social and political scientists, is that it departs from any one discipline though it has 'emphasis on uncertainty reduction and power apart from considerations of efficiency' (Pfeffer, 1997, p.63). The underpinning principle is that organisations are constrained by their interdependencies with other organisations and these interdependencies can be managed although never entirely successfully. This failure to control interdependencies is what results in power relations (Pfeffer, 1987; 1997) with some organisations attempting to reduce others' power over them or increase their own power over others in their environment when faced with resource dependence pressures. The main themes are discussed in the following sections.

2.4.2.1 The environment of organisations

Resource dependence theory does not strictly focus on organisational reality but wherever functional, fundamental processes occur (March & Olsen, 1984; Pfeffer, 1987). Pfeffer and Salancik (1978; Salancik, 1979) argue that organisations are highly dependent on, or even dominated by, environmental factors and resource dependence pressures and thus the environment is more 'task' or 'technically' oriented (see Oliver, 1997). The authors view an organisation as an open system that is dependent on contingencies in its external environment. By analysing the external environment of organisations, the authors were able to give understanding to why organisations act in certain ways and change their

structure. Managers can act to reduce environmental uncertainty and dependence when constrained by external factors. Pfeffer and Salancik (1978) evolved this premise around the central concept of organisational effectiveness, as a measure of how well the organisation can generate acceptable outcomes. In addition a central focus was also on constraints, or non-random events that cause an organisational response. The authors also had a notion of a field, similar to institutional theorists, only in so far as an organisation responds to pressures with activities and outcomes that are 'accounted for by the context in which the organization is embedded' (Pfeffer & Salancik, 1978, p. 39). This external focus allowed for a shared balance from the internal environment (for example, farmers, farm employees) so that attention could be given to where the constraints were actually located (for example, governments, competitors, professional bodies, communities). In the organisation's external environment there may be *possessors* of scarce resources, such as farmers diverting water into a storage upstream, or controllers of the *use* of scarce resources, such as governments issuing water access licenses and allocations. In addition, there will also be controllers of the *access* to scarce resources, such as environmental groups wishing to prevent diversions of water needed for the environment (Sheppard, 1995). The need for resources, in the case of this research, surface water in an agricultural setting obtained from the environment and safely stored, makes organisations externally dependent and highlights the criticality of a resource in the functioning of an organisation.

2.4.2.2 Responses to constraint

Selznick (1949) originally identified the potential for organisations to co-opt in the face of constraint to allow, even temporarily, the opportunity to gain access to scarce resources. In this context organisations are making a strategic choice to overcome constraint which can range from avoidance of demands through to compliance with, or management of such demands (Pfeffer, 1973; Pfeffer & Salancik, 1978; Burt, 1983; Sheppard, 1995). Pfeffer and Salancik (1978) did provide a concept of constraint absorption which means taking the rights to the control of dependencies away from the independent actor – making the dependent actor independent. The typical example in the resource dependence literature is through mergers and acquisitions where the organisation absorbs their competitor or rival firm in order to 'absorb the constraints' placed on them for scarce resources (Pfeffer, 1972; Pfeffer and Salancik, 1978). In the context of this research a suitable example would be a downstream farm acquiring an upstream farm in order to take control of any interceptions above them in the catchment, thereby absorbing the constraint on the scarce water resource. This is distinct from co-adaptation where a more powerful organisation gets involved in the independent actor's activities so as to gain some access to the resource, whilst maintaining independence. Recent literature however has found difference between

co-adaptation, constraint absorption and other ways of restructuring dependence on scarce resources (Casciaro & Piskorski, 2005). Constraint absorption implies the giving up of power completely to the formerly dependent party which highlights two important streams within resource dependence theory: power imbalance and mutual dependence (Casciaro & Piskorski, 2005).

2.4.2.3 Power

Power is a central concept in resource dependence theoretical analysis. The theory itself provides a 'unified theory of power at the organisational level of analysis' (Casciaro & Piskorski, 2005, p.167). The importance grew out of the notions of dependence and interdependence (Emerson, 1962; Blau, 1964). The focus on power also has the benefit of distinguishing resource dependence theory from transactions cost theory (Williamson, 1975). Power imbalance occurs when one actor faces greater uncertainty and worse exchange conditions and the other has a larger proportion as a result of the exchange (Friedkin, 1986). To reduce the uncertainty, the more dependent actor will attempt to change the situation through constraint absorption which is very likely to be resisted by the high power organisation (Casciaro & Piskorski, 2005). Conversely, a mutual dependence situation is likely to arise if organisations face great uncertainty and poor exchange conditions and the exchanges are more critical to their survival so the use of long term contracts or joint ventures, such as dam sharing, or even take overs are more beneficial as they release the uncertainty about resource procurement (Casciaro & Piskorski, 2005). Conceptually, power in the resource dependence theoretical context, also allows for an inward glance at the power of managers to manage dependencies independently and consequently, to have a crucial role in the survival of the organisation (Salancik *et al.* 1974). On the same token, the power of others in the farmers' environment is a critical consideration. Farmers are under considerable pressure from their environment and often they must change their water management practices which has a limiting effect on their power (Gafsi & Brossier, 1997).

2.4.2.4 Critiques of resource dependence theory

Despite the widespread use of the highly successful resource dependence theory (Casciaro & Piskorski, 2005), the framework departs from the 'rationalist, individualistic perspective' (Pfeffer, 1987) and by doing so, disregards organisations themselves as institutions and also the political nature of organisational choice (Pfeffer, 1997). The theory is also critiqued for not being able to specify which organisations in a field will be the adopters of change, only that resource scarcities will create increased competition for resource acquisition (Sherer & Lee, 2002). In addition, although the theory is widely cited

by organisational scholars, there is limited empirical work testing the theory itself or its tenets (Casciaro & Piskorski, 2005). Therefore, this research aims to utilise a combination of institutional and resource dependence theories in order to overcome the individual limitations and critiques of each approach. The resulting framework based on Oliver's (1991) seminal combination of the theories will be empirically tested in the field of sustainable farm dam management. The next section provides preliminary discussion of Oliver's (1991) unification of the two theories to form a typology of strategic responses to institutional pressure introduced briefly in the following section and developed further in Chapter 4.

2.4.3 A dual institutional and resource dependence theoretical framework of strategic responses to institutional pressures

As farmers and farming businesses are subject to both significant institutional pressures and critical resource dependencies, both theories offer an appropriate framework for the study. Both theories are able to offer complimentary explanations of why organisations adopt certain modifications to protocols and processes (Pfeffer & Salancik, 1978; DiMaggio & Powell, 1983; Greening & Gray, 1994; Oliver, 1997) as a response to institutional antecedents (Oliver, 1991). In addition, as can be seen from the preceding discussion, the substance and critiques of each theory leaves a gap for resource dependence perspectives even in light of the institutional way of looking at organisational structure and vice versa. The resource dependence perspective allows for a focus away from the purely social, to one where there is reality that does not focus entirely on the constituent groups that surround an organisation (Pfeffer, 1987). However, resource dependence theory, like institutional theory, still allows for considerations other than efficiency: those of uncertainty reduction and power. Christine Oliver's (1991) influential modelling of responses to pressure through an institutional and resource dependence strategic response typology (presented in full in Chapter 4) captures what seminal institutional theoretical authors noted about the importance of considering the way resource dependencies and requirements shape organisations. DiMaggio and Powell (1983) in their seminal piece on institutional isomorphism, note Pfeffer and Salancik (1978) and their approach to understanding organisations with unmanageable interdependencies seeking to use the power of the larger social system and regulatory bodies to eliminate uncertainties. Tolbert (1985) combined the two theoretical perspectives to explain administrative structure in higher education, finding that an institutional perspective predicated conditions under which hypotheses generated by a resource dependence perspective will hold.

Strategy can be said to be the important link between the two theories and facilitates their complimentary modelling. Institutional theory has faced criticism for its failure to address strategic behaviour and organisational influence over strategic responses to pressure (Covaleski & Dirsmith, 1988; DiMaggio, 1988). Resource dependence theory on the other hand allows for a focus on strategy at all levels and is in fact a primary theoretical perspective for understanding of intra- and inter-organisational strategic behaviours (Hillman *et al.,* 2005). Oliver (1991) recognised the need for a repertoire of possible strategic responses to institutional pressure. Given that resource dependence theory posits organisational actors, such as managers (in this case farmers) as seekers of reduction of uncertainty through exertion of power, Oliver's (1991) framework responded to the shortcomings of institutional theory in addressing strategic responses when used alone (Ingram & Simons, 1995). Drawing on resource dependence arguments highlights that organisational actors respond to pressures strategically, with more self-interest than originally considered by early institutional theoretical purists.

Oliver (1991) summarises the complementarities and dissimilarities between the theories on two levels: *context* and *motives*. For *context*, both theories assume that there are external pressures on organisations (Friedland & Alford, 1991; Pfeffer & Salancik; 1978), environments are critical and connected (DiMaggio & Powell, 1983; Pfeffer & Salancik, 1978) and power is at play in these environments (Pfeffer & Salancik, 1978; Scott, 1987; Scott, 2001). The theories diverge where resource dependence perspectives make assumptions about the degree of strategic choice and self-interest available to an organisation, where institutional theory emphasises the importance of merely conforming to environmental norms and rules, implying low resistance (Meyer & Rowan, 1977; DiMaggio & Powell, 1983). For *motives*, Oliver (1991) highlights the converging assumption of stability and legitimacy and how for institutional theory, self-interested behaviour is not theorised explicitly (Dowling & Pfeffer, 1975; Pfeffer & Salancik, 1978; DiMaggio & Powell, 1983; Zucker, 1986; DiMaggio, 1988). Therefore, the *motives* underlying stability and legitimacy are where the theories diverge most dramatically.

Institutional theory has a focus on stability and compliance with norms whereas resource dependence perspectives achieve legitimacy through exerting control or power over their resource environment. Compliance to achieve stability from the institutional perspective gives special emphasis to authority relations, especially the ability and desire of organisations to favour legitimate coercion (Scott, 1987). Non-compliance, on the other hand, drives toward legitimacy by strategically exploiting power and control (Pfeffer, 1982). This difference highlights that whilst institutional theorists will view compliance with norms as the best way to appear legitimate and achieve organisational stability, resource

dependence theorists see advantages of strategically pursuing non-compliance, including the maintenance of autonomy and discretion of their resource based decision making for scarce resources (Pfeffer, 1982). The divergent and convergent assumptions of each theory and the interpretation for this research are summarised in Table 2.1.

Table 2.1 - The divergent and convergent assumptions of institutional and resource dependence theories

(Oliver, 1991, p.147; Hessels & Terjesen, 2010, p.206)

		Institutional Theory	Resource Dependence Theory
Context	Environment and behaviour	Organisations operate in an institutional environment with non-choice behaviour that complies with norms, values and assumptions	Organisations operate in a task environment with active choices to strategically cope with interdependencies
	Changes to pressures	Organisations isomorph to invisible pressures to adhere to rules and norms	Organisations strategically respond to visible, physical pressures to manage scarce resources
Motives	Legitimacy and external criteria	Organisations seek legitimacy and social worthiness through conformity to external criteria	Organisations seek legitimacy and resource mobilisation through strategic control of external criteria
	Drivers and interests	Organisations are interest driven and comply to self-serve institutional defined interests	Organisations are interest driven and do not comply to self-serve political interests
Interpretation for this research	Individual theories	Farmers seek legitimacy in their field by managing their dams in a way that complies with the institutional surface water storage norms and values in their catchment and will change or isomorph in response to institutional pressure from government, industry bodies, and interest groups	Farmers operate in a task driven environment where water is a scarce resource and a critical farming input and make strategic choices about the way they manage their dams to cope with the interdependencies within a catchment
	Theories combined	Institutional pressures predict the occurrence of alternative farmer dam management strategies and the degree of conformance or resistance to those interests and pressures	
Seminal theorists	Individual theories	Selznik, Meyer, Rowan, Zucker, DiMaggio, Powell, Oliver, Scott	Pfeffer, Salancik
	Theories combined	Oliver, Cashore, Vertinsky, Tolbert, Carpenter, Feroz,	

DiMaggio (1988) recommended that institutional and political models should be complimentary tools for analysis. Oliver's (1991) work answered this call by identifying a range of strategic and tactical responses to institutional environments that contributes a dynamic model to be applied to this study. However, the problem when combining two high quality theoretical perspectives is that there will be sacrifice or compromise when modelling or explaining the study. In addition, there is some criticism of insurmountable disparity between the theories concerning their field of focus: institutional theory focuses on organisational interests where resource dependence theory focuses on the networks where competition for scarce resources is taking place (DiMaggio, 1988). However, the dual perspectives are perhaps more complimentary than early authors considered: an institutional perspective allows for emphasis of the role of external authority in imposing

arrangements, leaving a gap for resource dependence to retain focus on organisational efficiency and technical skill.

This research has the goal of identifying the level of resistance to institutional pressures on farmers to conform to a particular management practice and thus a combination of the two theories is employed. Goodrick and Salancik (1996, p.3) suggest that putting a strategic choice angle into institutional theory means that the 'social-fact' quality of institutions will be compromised and the dominant social agents will become the focus. The risk in combination is that institutional pressure just becomes a constraint 'to be managed like any other constraint' (Goodrick & Salancik, 1996, p.3). In addition, Tolbert and Zucker (1996, p.179) suggest that whilst the shift in institutional theory to explaining responses to resource pressure sources is positive for explaining how structures arise to address external actors' demands, the fundamental flaw is that the 'unique theoretical contributions' of institutional theory are obscured. The authors suggest the main problem may be the lack of voluntarism that appears in institutional theoretical analysis, thereby making out organisations to be low in resistance and conforming (see also Oliver, 1991). This research acknowledges this and so takes the institutional theory type approach – that is, beyond investigation of an actual outcome to pressure, but addressing how managers make discretionary choices along a spectrum of response. Marcus (1988) and Hrebeniak and Joyce (1985) highlight the importance of thinking along a continuum so that reciprocal relationships between variables can unfold. The authors highlight that the difference between voluntarism and determinism and how choice is both a cause and consequence of pressures from the environment, are critical to understanding organisational adaptations and behavioural responses (Hrebeniak & Joyce, 1985).

Whilst there has been diverse application of all or part of a dual institutional and resource dependence theoretical framework to sustainability management (particularly environmental, Cashore & Vertinsky, 2000; Bansal, 2005; Clemens & Douglas, 2005 and Clemens *et al.,* 2008 (environmental only); Kolk & Pinske, 2007; and recently, corporate governance, Okhmatovskiy & David, 2012) to the author's knowledge the combination has not been applied specifically to agriculture and water management. Whilst studies have used this dual theoretical framework to advance parts, or all of, Oliver's (1991) model (see for example, Etherington & Richardson, 1994; Goodstein, 1994; Ingram & Simons, 1995; Milliken *et al.,* 1998; Cashore & Vertinsky, 2000; Clemens & Douglas, 2005; Jacobson *et al.,* 2007; Clemens *et al.,* 2008; Grafton *et al.,* 2011), this thesis aims to investigate systematically and empirically the contribution of the perceptions of different institutional pressures within four distinct institutional environments relating back to the organisations studied. To the author's knowledge, this has not previously been undertaken. Importantly,

this thesis advances and further tests the model in the novel setting of agriculture and as it relates to dependence on water, and resulting sustainable management, a critical issue of our time. The dual theoretical framework is built upon with Oliver's (1991) strategic response and institutional antecedent typology for conceptual model development resulting in empirically testable hypotheses in Chapter 4.

This study not only adds a valuable empirical test of the dual institutional and resource dependence theoretical foundation in an agricultural and water setting, but also applies the framework to an issue of sustainable management, an area in ever increasing need of attention. In addition, Oliver's (1991) framework addresses any weakness in each theoretical foundation and allows for full exploration of the dual perspectives' emphasis on external pressure and response. However, in order to provide context for the review of the sustainable farm dam management institutional environment (Chapter 3) for inclusion in empirical modelling (Chapter 4) and testing (Chapter 6), the elements that make up this environment need to be considered. The key elements of the sustainable farm dam institutional environment are drawn from the farm dam management literature in the following sections.

2.4.4 The sustainable farm dam management institutional environment

The research from the literature reviewed suggests that surface water runoff stored in farm dams is managed in a way that leads to many unsafe structures (Pisaniello, 1997; Pisaniello & McKay, 2003, 2005; 2007) and over-allocation and over-use of water (Young & McColl, 2009). This unsustainable management behaviour highlights the need for serious attention to the institutional environment in which the practice is taking place, which this research aims to address.

The key elements of the sustainable farm dam management institutional environment are the equity and safety 'specific institutional mechanisms that influence the context for industry' (Hirsch, 1975, p.328). The equity and safety mechanisms for sustainable farm dam management practice are embedded in an institutional environment that can include (1) governments (DiMaggio & Powell, 1983), (2) professional and industry bodies (Tolbert & Zucker, 1983), (3) financial groups like banks and insurers (D'Aunno *et al.*, 1991), (4) community groups (Delmas & Toffel, 2004), (5) environmental interest groups (Delmas & Toffel, 2004; Campbell, 2007), and (6) the media (Bansal, 2005) as summarised in Table 2.2.

Table 2.2 - The institutional environment of sustainable farm dam management practice

(Etherington & Richardson, 1994)

Institutional environment actor	Incentive for compliance
Government	Equity and/or safety regulation fines, threat of penalties, opportunity for grant support
Industry/Professional bodies	Funding, media support, submissions to policy development, opportunity for increased supply chain legitimacy
Financial bodies	Threat of increased costs of finance and insurance
Community and environmental groups	Threat of legal action, negative media attention, opportunity for increased supply chain legitimacy
Media	Threat of negative attention causing detriment to supply chain legitimacy

The farm dam management literature (Pisaniello, 1997; Baillie, 2008; Pisaniello, 2009; 2010; 2011; Pisaniello *et al.*, 2011b) identifies the main sustainable farm dam institutional elements as follows: (1) Content of regulations and the integration of equity and safety mechanisms into overarching sustainability management, (2) Accountability for equity and safety monitoring, (3) Accountability for equity and safety of small dams, and (4) Equity and safety reporting demands. These four main equity and safety mechanisms that emerge from the institutional environment of sustainable farm dam management will be discussed as follows.

2.4.4.1 Content of regulations and the integration of equity and safety mechanisms into overarching sustainability management

The content structure of any regulation in place and level of integration of equity and safety farm dam sustainability mechanisms is a critical part of a farm dam management institutional environment. Setting specific rules, de facto standards, codes and regulations on sustainable farm dam management which dam owners must follow by law, provides a level of regulatory certainty (Eisner, 2004). Yet, private dams, such as those typically identified as farm dams, are often ignored by regulations despite the serious individual and cumulative equity and safety problems (Pisaniello, 2011). Furthermore, whilst many governments around the world have made progress toward water storage regulation mechanisms to improve water *sharing* in catchments, they continue to ignore the critical dual extreme problem of water *safety* in catchments (Pisaniello *et al.*, 2011a).

2.4.4.2 Accountability for equity and safety monitoring

Accountability from government under equity and safety regulation or other demands from institutional farm dam sustainability actors can be evidenced in the establishment and maintenance of a dams register by key institutional actors. A continuously maintained

register of existing dams enables monitoring of any changes to the dam over time (Pisaniello and McKay, 2007). An active list of dams also facilitates the general status of the spillway for fair water sharing and safety to be monitored (Tingey-Holyoak *et al.*, 2011). However, heightened accountability from the institutional environment can be challenging to establish. Absence of true market competition for government makes their motivators different from other institutional actors (Bowerman *et al.*, 2002) therefore recording and monitoring the equity and safety of farm dams is often an issue that is ignored (Tingey-Holyoak *et al.*, 2011). ANCOLD (2003, p.3) specify that if legislation is designed to protect the community from unsustainable farm dam management then it '…should establish regulatory authorities that ensure dam owners, and potential dam owners, are taking appropriate actions…' (ANCOLD, 2003, p.3). Pisaniello (2010) suggests that accountability for sustainable farm dam management can be achieved by increasing the number of dams recorded and monitored.

2.4.4.3 Accountability for equity and safety of small dams

As previously established in Chapter 1, failures of large dams are more spectacular and receive much more attention than those of smaller dams. The real-world problem is that small dam failures, particularly those of privately owned farm dams, occur far more frequently (see Chapter 1, Section 1.1.2; Lewis & Harrison, 2002; Tingey-Holyoak *et al.*, 2011; Pisaniello *et al.*, 2011b). Furthermore, this chapter has established that the unfair sharing of water from small farm dams, such as those commonly used for stock and domestic watering, on a cumulative scale can be extremely significant (see Section 2.2.3.1; Nathan *et al.*, 2005). Therefore, the size of dams captured by regulatory or other institutional farm dam sustainability mechanisms emerges as an important element of the farm dam management environment. Previous research in the area (see Pisaniello, 1997; Pisaniello & McKay, 2005; 2007; Pisaniello, 2010) has established that most small dams in a catchment should be supervised, especially when in the catchment of a large downstream dam. Small farm dams should be registered and at least controlled for spillway adequacy regardless of their individual hazard potential (Pisaniello, 2009).

2.4.4.4 Equity and safety reporting demands

The fourth equity and safety mechanism of sustainable farm dam management, identified in the literature as strengthening the institutional environment, is reporting for regulatory or other institutional farm dam sustainability mechanisms. Farm dam reporting strategies are not widespread and remain an element of the sustainable farm dam management institutional environment that is often ignored (Pisaniello *et al.*, 2011b). A general lack of water storage management records, reports and assessments (Gibbings & Raine, 2005)

mean that often the most basic measurements, recordings and details are only brought to light in times of emergency, such as when there is a major drought crisis (Lake & Bond, 2006) or a focus on deaths caused by dam failure (for example, Jakarta Situ Gintung dam failure, BBC, 2009). Emergency action plans and other reporting, in accordance with ANCOLD (2000b; 2003) guidelines, require owners of significant to high hazard dams to arrange safety inspections and reports by an experienced dam engineer after the initial filling of the reservoir and generally every 5 years during the life of the dam (Pisaniello, 2009). Emergency action plans further satisfy the 'Community Right to Know' principle as downstream communities are made aware of the risks and danger they are living under and provided with the opportunity for escape in the event of dam failure (Tingey-Holyoak *et al.*, 2011, p.304).

Table 2.3 summarises the above discussion of the four equity and safety mechanisms of the sustainable farm dam management institutional environment in context of key institutional actors.

Table 2.3 – Elements of the institutional environment of sustainable farm dam management practice

Equity and safety mechanisms of farm dam management institutional environment	Detail	Key institutional actor
Content of regulations and the integration of equity and safety	Regulated for use (equity) + regulated for size (safety) + integration of both mechanisms	Regulators
Accountability for equity and safety monitoring	Number of dams captured by regulations, norms or guidelines and monitored	Regulators, industry/professional bodies, financial bodies, community and environmental groups, media
Accountability for equity and safety of small dams	Size of dams captured by regulations, norms or guidelines	Regulators, industry/professional bodies, Financial bodies, community and environmental groups, media
Equity and safety reporting demands	Surveillance reports, safety reports, emergency action plans	Regulators, informally to industry/professional bodies, financial bodies, community and environmental groups

Chapter 3 will review the Australian sustainable farm dam management institutional environment across these four criteria.

2.5 Summary

The purpose of Chapter 2 is to highlight the serious problem of farm dam sustainability and position the critical issues within a sociological framework for examination of farmers' strategic responses to institutional pressures in the following chapters. The fundamentals of farm dams are discussed and then placed into the broader sustainability agenda where sustainable farm dam management and cumulative farm dam problems for farmers and

communities can be considered. Important theorising within institutional and resource dependence theories is discussed in the context of sustainable management of farm dams and the dual theoretical framework presented that will form the foundation of the empirical study. The limitations to the theoretical modelling are acknowledged and addressed.

Chapter 2 finds a gap in the application of theory to the problem of agricultural surface water storage and contributes a dual institutional and resource dependence theoretical framework in order to explain the strategic responses of farmers to manage surface water sustainably. Oliver's (1991) full model will be built upon in Chapter 4 in order to generate a series of variables and hypotheses for empirical testing and development of the framework for answering sub-Research Question 2: *What are the institutional pressures that can cause a sustainable management response from farmers?* Before discovery of the institutional pressures and the model is presented in Chapter 4, the sustainable farm dam management institutional environment in Australia will be reviewed in Chapter 3. This chapter concluded by addressing the key elements of the sustainable farm dam institutional environment that will serve to form the foundation of the review, endeavouring to answer sub-Research Question 1: *What are the equity and safety mechanisms in the institutional environment of farmers managing farm dams?* The following chapter will also facilitate the choice of test study states for inclusion in the modelling and analysis.

Chapter 3

Review of equity and safety mechanisms in the institutional environment of farmers managing farm dams

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3.1 Introduction

In order to provide the depth of understanding required to analyse the problem of sustainable farm dam management response to institutional pressures, the equity and safety mechanisms of the institutional environment of farmers managing farm dams need to be identified. In Australia, although there are estimates of over 735,000 farm dams (Baillie, 2008) the numbers vary between states and territories. Likewise, between states and territories there are varied equity and safety mechanisms for sustainable on-farm water storage in place. Therefore, each state and territory in Australia is examined in order to identify the strength of institutional environment each jurisdiction represents.

The main purpose of Chapter 3 is to focus on the second part of the overarching research problem, Research Problem 2, and develop understanding of the equity and safety mechanisms in the sustainable farm dam management institutional environment of farmers in Australia. To address this research problem, depth of understanding is provided through an institutional review of mechanisms in Australia from publicly available sources, such as policy and regulations, internet-based documents, and the related literature. The chapter commences with a brief discussion of the method of review, followed by an introduction of the sustainable farm dam management institutional environment in Australia. The review of all states and territories follows summarised with the development of a ranking of jurisdictions on a sustainable farm dam management scale from 'weak institutional environment' to 'very strong institutional environment'.

3.2 Policy, internet-based, and literature reviews

Available data from multiple sources was used to compile information on farm dams in the two territories and six states in Australia: The Northern Territory (NT), The Australian Capital Territory (ACT), Western Australia (WA), Queensland (QLD), Tasmania (TAS), South Australia (SA), New South Wales (NSW), and Victoria (VIC). In addition to a review of the relevant literature, publicly available policy and supporting documents related to sustainable farm dam management were included in the study. Archival research included

both electronic (that is, internet-based) and hard-copy information gathered from licensing databases, for example the Tasmanian Department of Primary Industries and Water (DPIW) website which provides licensing details of all registered dams in Tasmania (DPIW, 2012).

An internet-based review was undertaken for any other institutional actor involvement in farm dam issues (for example, industry body, financial group, community/environmental group, or media), in addition to a review of other studies that address farm dams in Australia for any reason (for example, Baillie, 2008; McMurray, 2004; 2007). The existing sustainable farm dam management institutional environment literature was also reviewed in depth (Pisaniello, 1997; 1998; 2009; 2010; 2011; Pisaniello *et al.*, 2011a; 2012). In some cases there was little information available, especially as related to institutional actor involvement other than regulators. Nevertheless, the review of available information was useful for further consideration of any potential voids in the sustainable dam management institutional environment of farmers for survey questionnaire development (see Chapter 5, Section 5.4.2.2).

3.3 Equity and safety mechanisms of the sustainable farm dam management institutional environment in Australia

In Australia, farming has witnessed significant agricultural land use changes in the past century (Garnaut, 2008). The intensification of land use as a consequence of attempting to secure greater economic yield from each hectare puts pressure on inputs, including surface water runoff captured in farm dams (ANRA, 2009a). The number of farm dams in each state and territory in Australia is presented in Table 3.1 in the context of the surface area and human population of each state.

Table 3.1 – Key characteristics of each state and territory in Australia with relation to farm dams

(Murley, 1987; Pisaniello & McKay, 2005; Baillie, 2008; Ditchfield, 2008, pers.comm. 25 June; ABS, 2007; 2010a; 2011; AGGA, 2009; Ciganovic *et al.*, 2009)

	Northern Territory	Australian Capital Territory	Western Australia	Queensland	Tasmania	South Australia	New South Wales	Victoria
Human Population	0.23 million	0.37 million	2.37 million	4.60 million	0.51 million	1.13 million	7.22 million	5.53 million
Surface Area	1,349,129 km^2	2,358 km^2	2,529,875 km^2	1,730,648 km^2	64,519 km^2	983,482 km^2	800,628 km^2	227,010 km^2
Farm Dam Population	n/a*	1,000	3,800	6,400	8,000	38,000	300,000	300,000

Increasing number of farm dams

*No data was available for NT where there is a large network of small storages that are predominantly fed by ground water systems and have no requirement for licensing, metering or monitoring (Baillie, 2008).

Federally, at the level of the Australian Government, there is little involvement in sustainable water storage since the overturning of the riparian doctrine in the late 1800's which served as an institutional 'first rights' mechanism to overcome disputes over water storage issues (Musgrave, 2008). From an equity perspective, each state now retains 'superordinate legal status over water resources' despite suggestion that a federal approach would leave less room for interpretation by, and differences between, states that currently exists (Crase, 2008, p.4). Fortunately, the Council of Australia Governments (COAG) competition policy reforms between 1994 and 2004 are allowing for a shift to a more national institutional focus and restructuring reforms for each state through a National Water Initiative (NWI) based around principles of sustainable development (McKay, 2008; see Chapter 2, section 2.3 for discussion of Brundtland Report definition of sustainable development). From a safety perspective, there are no institutional mechanisms to govern the safety of on-farm water storage at a federal level, despite international reviews in places such as Finland and the United States of America, that highlight the positive outcomes of a national scheme (see Pisaniello, 2011).

An overview of Australia from each arm of the sustainable farm dam management problem (equity and safety), and their integration, will be discussed in the following sections.

3.3.1 Equity mechanisms in the institutional environment of farmers managing farm dams in Australia

In most countries, equity mechanisms of the institutional environment of sustainable farm dam management are dominated by underlying regulation as land and water rights are usually closely related. Although water and run-off is often a public resource, its use is usually associated with permits, concessions, and other institutional systems (Stephens, 2010). In many countries, surface water irrigation is managed at the highest level of the institutional hierarchy by a combination of state and federal government arrangements that provide agreement of the shared water resource as 'common property'. The states then take control by assigning common property rights to entities (like natural resource management boards) or directly to licensed users or riparian right holders (Crase & Dollery, 2008).

A significant difference in decision-making and approach to licensing and allocation of equitable farm dam water storage exists between Australia and elsewhere in the world (Young & McColl, 2009). In the USA and other countries it is not common to develop water sharing plans in consultation with stakeholders, to determine when and how water is allocated to users and the environment, in order to avoid room for interference, complications and delays, such as that by politicians (Williamson, 2011) and lawyers (Young & McColl, 2009). The challenge in Australia remains the development of adequate sustainable farm dam management institutional frameworks that deal with the rapidly increasing variations in the political and environmental climate (Crase, 2008).

From 1994 each State had the opportunity to look holistically at water management and revised their water laws to incorporate some form of water sharing institutional mechanisms. Since this time there have been moves for increased sustainable farm dam management in each state and territory (McKay, 2008). Regulations on water entitlements to create titles more in line with the National Water Initiative (NWI) are in place in Victoria, New South Wales, Tasmania, South Australia, Queensland and the Australian Capital Territory, but not yet in Western Australia or the Northern Territory (NWC, 2012). However, interception activities, such as the capture of surface water in farm dams are not being monitored uniformly across the country (NWC, 2012). Despite the fact that on 3rd July 2008, the Australian Government and the governments of New South Wales, Queensland, South Australia, Victoria and the Australian Capital Territory (the basin states) signed the Intergovernmental Agreement on Murray Darling Basin Reform, to enter into water management partnership agreements (WMPAs) to give effect to water reforms in the basin, the response at a local level has been lagging (NWC, 2012). These WMPAs are

designed to improve sustainable rural water use in the basin but without significant improvements in knowledge of the amount of farm dams and the water they capture in some states such as Victoria (Brown, 2011, pers.comm. 3 May), there is a major part of these agreements missing (Lowe *et al.,* 2005).

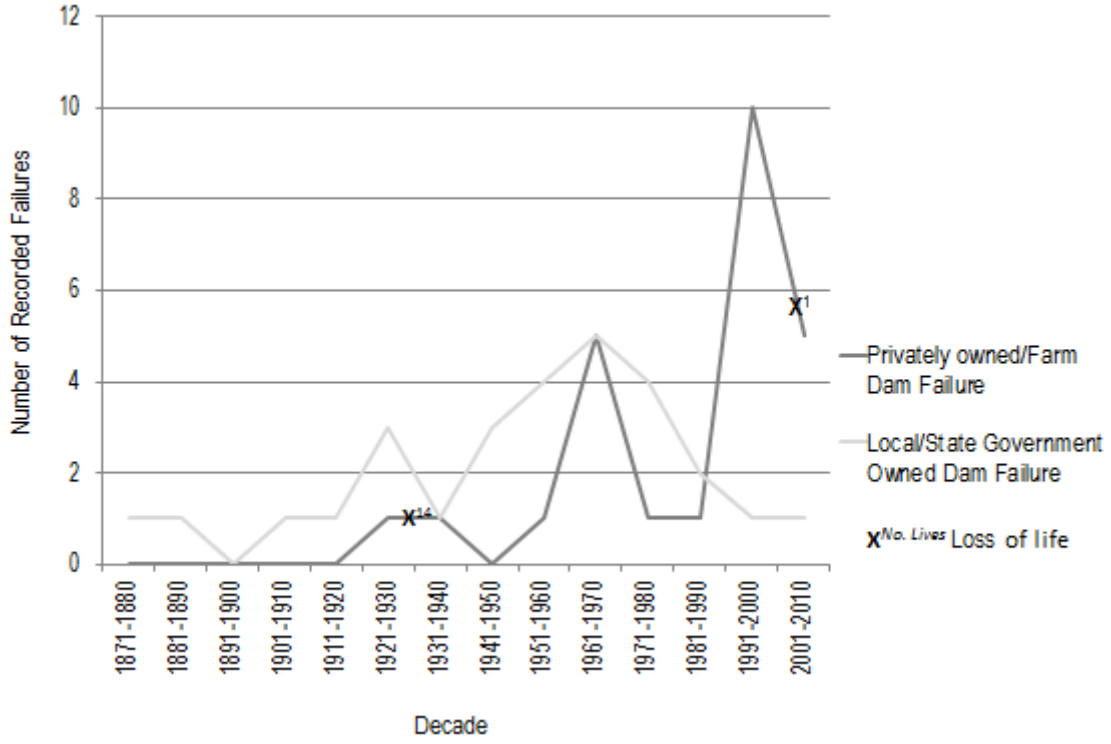
3.3.2 Safety mechanisms in the institutional environment of farmers managing farm dams in Australia

There have been comprehensive reviews of safety mechanisms of the farm dam management institutional environments in the USA, Canada, United Kingdom, Finland, Portugal and South Africa (Pisaniello, 1997; 2011; Pisaniello & McKay, 1998; 2007). Results of the reviews find that farm dam safety mechanisms vary between and within countries although key components in certain practices can be identified, particularly from the regulatory arm of the institutional environment. Common mechanisms of successful institutional arrangements include mechanisms of common law and legislation, some command and control regulation, registration and classification of dams, and accountability and reporting (Pisaniello, 1997; Pisaniello & McKay, 1998; 2007; Pisaniello *et al*., 2011a). Pisaniello (2011) finds that internationally, where there is significant institutional pressure for safe farm dam management, mechanisms of best practice are emerging where the proper safety management of farm dams, both at the individual and cumulative levels within catchments, exists to provide assurance to communities and businesses downstream. Internationally there are examples of appropriately devised dam safety programs in certain parts of the US, Canada, the UK, South Africa, and Finland (Pisaniello, 2010).

Despite research and overseas experience demonstrating that the cumulative impact of inadequate farm dams in a catchment can have a catastrophic impact on downstream communities and the environment (see Pisaniello & McKay, 2006), in many Australian states, privately owned farm dams are storing more than their entitlement (Pisaniello *et al.*, 2012) and may pose significant threat, or even have failed already. An update of Pisaniello's (1997) review of recorded dam failures for the current thesis finds private (farm) dam failures increasing (Figure 3.1). However, the reality of the dam failures that remain unrecorded could be substantial (Yeomans, 1958; Adams, 2000).

Figure 3.1 - Recorded Dam Failures* in Australia

(Ingles, 1984; Pisaniello, 1997; Lewis and Harrison, 2002; Barbeler and Dunlevy, 2008; ABC, 2009; Carstens, 2009; Harvey, 2010; Schranz, 2010, pers.comm. 17 September)



*'Failure' refers to a lack of performance as originally intended, which has resulted in a loss of life and/or substantial costs for rectification (that is, more than US$1,000,000) and/or damage to the environment (Ingles, 1984; Pisaniello, 1997).

Figure 3.1 reinforces the need for institutional rules and norms (formal from government and professional bodies or informal through embedded social systems) to govern the sustainable storage of water, which is also recognised in the literature (see Coop & Bruckhorst, 1999; Pisaniello, 2009).

Yet, uniform regulation nationally has not been forthcoming (Pisaniello, 2011). What remains is the owner responsibility that exists under common law to manage dams according to current standards (McKay & Pisaniello, 1995; Pisaniello & McKay, 2007) and in Australia, these standards are set by the Australian National Committee on Large Dams (see ANCOLD 2000a; 2000b; 2003). However, to rely solely on common law responsibility does not protect downstream communities, property and the environment from unsustainable farm dam management (Pisaniello, 2009; Tingey-Holyoak *et al*., 2011). Therefore some states have responded individually. The development and surveillance of dams is controlled by legislation and regulations in Queensland, NSW, Victoria and Tasmania (ANCOLD, 2011a). No other states or territories have any specific legislation that covers safety, environmental, cultural heritage and other issues of value to the community. The standards in place in these states require compliance with the ANCOLD

guidelines to varying degrees (ANCOLD, 2011a). The following section considers integration of safety legislation into water sharing and equity guidelines as an approach for sustainable farm dam management.

3.3.3 Integration of farm dam water storage equity and safety institutional mechanisms in Australia

In Australia, there has been integration of some dam safety regulations into the water equity institutional mechanisms (Pisaniello & McKay, 2005; 2007). However, these integrated equity and safety mechanisms usually target larger dams with their individual hazard and ignore farm dams deemed to pose no proximate threat to downstream communities (Pisaniello *et al.*, 2011a). The two mechanisms in the sustainable farm dam management institutional environment identified by this research (water sharing equity and structural safety) are often considered as separate problems which is unfortunate as they are highly interconnected. Integration of equity and safety institutional mechanisms is therefore a positive approach to surface water management (Pisaniello *et al*., 2011a).

Rather than disconnected pulls from the institutional environment, integrated water resources management is the practice of making decisions and taking actions while considering multiple viewpoints of how water should be managed, such as from engineering, policy and agricultural perspectives. The combination of different disciplines when making decisions relating to equity and safety issues such as catchment planning, storage estimation, controlling reservoir releases, regulating floodplains and developing new laws and regulations is a critical approach (Pahl-Wostl, 2007). Tasmania, Victoria and Queensland fully integrate water sharing and equity planning and regulation, all with guidelines based on NWI principles for water equity planning and ANCOLD's guidelines for safe and sustainable farm dams to varying degrees (DPIWE, 2005; DSE, 2007; DERM, 2012). More detail on each of these state's institutional environments is provided in Section 3.4. But firstly, involvement of other key actors in the sustainable farm dam management institutional environment is addressed as follows.

3.3.4 Involvement of other institutional actors in farm dam water storage sustainability in Australia

Despite increasing attention to sustainable farm dam management, there is little publicly available information on the approach taken by other actors in the sustainable farm dam management institutional environment. And even though institutional environment constituents' combined involvement in serious farm dam failure or crisis would be

considerable, there is immaterial evidence of involvement in sustainable farm dam management.

For example, if a dam is managed unsustainably then it poses an economic risk to the community, the environment and to the farmers operations. Despite weather events in the country demonstrating increasing severity, insurance company and mortgage provider farm dam caveats do not appear to be a substantial part of the institutional environment of sustainable farm dam management. There is no publicly available information to suggest that insurers or bankers require monitoring and reporting of sustainable farm dam management to obtain insurance or loans. However, this could be different in reality and thus perceptions of farmers would be required to understand this fully (see Chapter 6, where this is tested).

Farming professional bodies are another key actor in the institutional environment of farmers managing farm dams. The overarching peak farming professional body is the National Farmers' Federation (NFF) which was formed in 1979 and represents farmers, in addition to all of the major state and industry-based bodies across Australia (NFF, 2009). The NFF have made public comment and been involved with media releases for moves to regulate farm dam management activities. For example the NFF are supportive of reducing farmer costs for administration of water trading from farm dams and are also concerned about the pressure this initiative would place on already constrained water resources around Australia, particularly in the Murray-Darling Basin where there has been considerable voice over sustainable surface water diversion limits (NFF, 2009). There are also environmental protection specific farming groups that bring up issues of sustainable surface water use more generally, such as the Environmental Farmers Network (McDonald, 2011). The NFF and other community and environmental groups have been less involved in dam safety however with no information publicly available to the best of the author's knowledge and so the perceptions of farmers of their involvement is gathered in this study by survey results (presented in Chapter 6 and discussed in Chapter 7).

The Australian National Committee on Large Dams (ANCOLD) is an independent body that focuses on providing guidance in achieving excellence for all aspects of dam engineering and management. However, the focus is mainly on 'large' dams (ANCOLD, 2011b). Although, the organisation does acknowledge the role of small dams and recognises that the 'cumulative value of these smaller dams is substantial' (ANCOLD, 2011b, p.3-4). Importantly, ANCOLD does contribute to the preparation and issuing of guidelines which 'represent the best Australian and international engineering practice' (ANCOLD, 2011b, p.2) which can then be used by governments to create or develop safe design,

management and operation guidelines for dams of any size. Beyond ANCOLD's involvement in contributing towards any government guidelines in place around Australia, there is little involvement from professional bodies, special interest groups, and the media in farm dam sustainability. The farm dam sustainability institutional environment is dominated by government constituents at state level to varying degrees of strength between states as will be discussed in the following sections.

3.4 The equity and safety mechanisms of the sustainable farm dam management institutional environment in Australian states and territories

The four important elements of a farm dam sustainability institutional environment captured from the prior work in the area (Pisaniello, 2009; 2010; 2011; Pisaniello *et al.*, 2011a) has been detailed in Chapter 2 (Section 2.4.4). These four sustainable farm dam environment elements are: (1) Content of regulations and the integration of equity and safety mechanisms into overarching sustainability management, (2) Accountability for equity and safety monitoring, (3) Accountability for equity and safety of small dams, and (4) Equity and safety reporting demands (Pisaniello, 1997; Baillie, 2008; Pisaniello, 2009; 2010; 2011; Pisaniello *et al.*, 2011a; 2011b). Each state and territory's sustainable farm dam management institutional environment is addressed below according to these four elements.

3.4.1 Content of regulations and the integration of equity and safety mechanisms into overarching sustainability management

It has been established in the above sections and in Chapter 2 (Section 2.4.4.1) that the content of sustainable farm dam management regulation and integration of equity and safety farm dam sustainability mechanisms are critical elements of the institutional environment.

3.4.1.1 The Northern Territory

The Northern Territory administers water resources under its newly amended Water Act (2011) however any new farm dam licensing requirements are highly dependent on the location of the dam (Baillie, 2008). Though, because there are few suitable dam sites, combined with high evaporation rates, a reliance on ground water and high rainfall (averaging 1500mm per year, ANRA, 2009b) the Northern Territory does not regulate extraction of surface water from farm dams at the moment (NWC, 2005). Low proportions of water-intensive agriculture (ANRA, 2009c) and very little irrigation (Baillie, 2008) also

mean that safety pressures are not a part of the institutional environment for existing farm dam managers/owners (Water Act (2011)).

3.4.1.2 Western Australia

In Western Australia there are currently attempts being made to strengthen the equity monitoring of surface water capture in farm dams, however, this has been challenging for the state and the lack of reporting at the government level has meant that delays exist with Western Australia's equity policy (NWC WA, 2012). The Western Australian Rights in Water And Irrigation Act (1914) was amended in 2000 (Rights in Water and Irrigation Amendment Act (2000)) which broadened the focus on water and now the state has 80 per cent of its water resources covered by a non-statutory water allocation plan or by license arrangements (NWC WA, 2012). However, the focus for farm dams is on new construction, not existing dam extraction. Western Australia is also dam safety mechanism absent (ANCOLD, 2011b).

3.4.1.3 The Australian Capital Territory

In the Australian Capital Territory there is substantial water equity planning in place, and under the Water Resources Act (2007), surface water captured by farm dams falls within the bounds of statutory Environmental Flow Guidelines. Unlicensed basic landholders rights are identified in the Act however, as in most states, the focus is on 'new farm dam installations', and even new stock and domestic farm dams do not require a licence (Water Resources Act (ACT) 2007) - as it is in most states and territories (NWC ACT, 2012). There is no safety legislation in place in the ACT (ANCOLD, 2011b).

3.4.1.4 South Australia

In South Australia, interest in the health of catchments surrounding the Murray-Darling basin meant that a conservative regime of water allocations and a relatively strong water equity policy was established early (Clark, 1971; Crase, 2008). Lower limits and stricter controls on new and existing dams occur in prescribed areas which cover most of the State however, only for irrigation or stock intensive use – stock and domestic is largely unregulated (Water Resources Act (1997)). The Western Mount Lofty Ranges is the largest concentrated region of catchment dams in the state (approximately 22,000, see Murley (1987)) however farm dam equity policy planning has stalled in the region because of political disruption and stakeholder dissatisfaction with the possibility of metering and charges for water stored in not only irrigation, but stock and domestic dams over 5ML (Littlely, 2011; Williamson, 2011). It does appear that the regulations will now only target 'large dams' as in many other states and territories in Australia (ABC, 2011). Despite the

large number of farm dams in the state (see Table 3.1), South Australia continues to operate in the absence of any safety legislation (Pisaniello & McKay, 2005; 2007; NWC SA, 2011).

3.4.1.5 New South Wales

New South Wales is strong from both sides of the sustainable farm dam management problem. The state complies with ANCOLD's dam safety guidelines (NSW DSC, 2012) through a government funded body; and also strongly follows the National Water Initiative's stringent approach to water planning (NSW OOW, 2012) by capturing existing farm dams for equitable water sharing. However, the state maintains completely separate bodies for sustainable farm dam equity and dam safety (Pisaniello *et al.*, 2011a). In NSW, any issues of dam safety are left up to the Dams Safety Act (1978) administered by the New South Wales Dams Safety Committee (NSW DSC). The Act parallels international best practice in terms of the levels of supervision and responsibility imposed upon dam owners (Pisaniello & McKay, 1998; Bradlow *et al.*, 2002), but remains entirely separate from any other sustainability mechanisms.

3.4.1.6 Queensland

In Queensland, key water allocation provisions have been incorporated into the Water Act (2000) and include licensing requirements for any interference with water by capturing in farm dams, depending on whether the catchment has regulated or non-regulated capture of runoff (Baillie, 2008). A water entitlement system has established the power to regulate farm dams, and in sensitive catchments water resource plans used these powers to prevent the construction of new farm dams for other than stock and domestic purposes (Water Act (2000)). These water storage equity mechanisms are integrated with dam-safety provisions that focus on 'referable' dams (DERM, 2011). Oversight of all referable dams is undertaken by the Department of Energy, Resources and Mines (DERM) based on their own setting of failure impact ratings, for which DERM is given the power to assign under the Water Act (2000).

3.4.1.7 Victoria

The institutional environment is strong in Victoria from both the content and integration of the equity and safety sustainability mechanisms. The Victorian Water Act (1989) not only requires *new* use of water for commercial and irrigation purposes from all private dams located on or off waterways to be licensed, but the 2002 changes to the Act requires owners of *existing* irrigation and commercial dams to obtain a registration ('Take And Use') License to take and use water from the dam (Water Act (1989) Incorporating the Water

(Irrigation Farm Dams) Act (2002)). Farmers have a right to domestic and stock water without a license. Victoria also strongly integrates farm dam equity and safety planning and regulation (Sustainable Water Resources Management and Irrigation Farm Dams (2001)) which requires owners of farm dams to obtain, in addition to the 'Take and Use' license, an operating license for water storage safety of large dams (DSE, 2007). The regulations are enacted by the Department for Sustainability and the Environment (DSE) but administered by rural water corporations who are based regionally and can more readily issue licenses and undertake monitoring (Water Act (1989)).

3.4.1.8 Tasmania

The Tasmanian rules-based institutional environment has integrated water storage equity and safety mechanisms, and takes a very strong stance from both sides of the sustainable farm dam management problem. From a water storage equity perspective, Tasmanian farm dam owners require a license and allocation to store water in farm dams for farming and commercial purposes (Water Management Act (1999)). The Department for Primary Industries, Parks, Water and the Environment (DPIPWE) in Tasmania has been delegated the power to grant or refuse water licence applications in accordance with the Water Management Act (1999) and only stock and domestic users are exempt. From a safety perspective, Tasmanian regulations detail strict specific safety measures to be required for the design, construction and operations of all dams based on size and hazard potential (Pisaniello, 2011) and administer these regulations in tandem with the equity policy.

3.4.1.9 Summary

From review of the first element of the farm dam management institutional environment, content of regulations and the integration of equity and safety mechanisms into overarching sustainability management, Table 3.2 ranks the states and territories from the 'weakest' content and integration to the 'strongest' content and integration. From this very preliminary position in the review of the farm dam management institutional environment, Tasmania, Victoria and Queensland, are identified as being at the 'strong' end of the tendency because they are the only states with integration of equity and safety mechanisms. The Northern Territory and Western Australia are removed from any further review or analysis of the sustainable farm dam institutional environment in Australia at this point as they have not well-established, or have non-existent, equity and safety mechanisms.

Table 3.2 – Content of regulations and the integration of equity and safety regulations into overarching sustainability mechanism in Australia

Element of institutional environment	Northern Territory	Western Australia	Australian Capital Territory	South Australia	New South Wales	Queensland	Victoria	Tasmania
Equity regulatory mechanisms	×	×	✓	✓	✓	✓	✓	✓
Safety regulatory mechanisms	×	×	×	×	✓	✓	✓	✓
Integration of equity and safety mechanisms	×	×	×	×	×	✓	✓	✓



3.4.2 Accountability for equity and safety monitoring

Accountability under institutional farm dam equity and safety mechanisms is critical for any sustainable dam management approaches to be successful (see Chapter 2, Section 2.4.4.2). This research identifies a proxy for accountability as the number of dams supervised for their sustainable management in a jurisdiction. From an equity perspective, the available data is inconsistent and challenging to aggregate. The 2010 Water Account (ABS, 2010b) presents significant information on the supply and extractions of groundwater and river water, however water use associated with farm dams is often only partially monitored through metering or ignored altogether, at this point. Although it is possible to capture existing dams through metering programs, so far they have been poorly implemented, if at all (NWC, 2011). The main drive for government level accountability of farm dam water sharing has been on 'new' dam applications or very large irrigation dams. Most states are currently developing a range of new accountability tools but have little confirmed in place at the moment (NWC, 2011). Therefore, exact accountability numbers for equity and fair water sharing from farm dams is not possible to ascertain, and thus the discussion following is focused only on the four states with safety mechanisms in the sustainable farm dam institutional environment.

3.4.2.1 New South Wales

The dams of interest to the NSW Dam Safety Committee (DSC) are a total of 372 that if failed would threaten lives or cause significant economic or environmental impacts (NSW DSC, 2011). Of these 372 dams 83 are identified as basins which are shallow retaining structures that are designed to withhold floods in urban areas, and 96 of the dams are

tailings dams which contain the waste from mining material (NSW DSC, 2011). However, in the institutional environment of privately owned farm dams in New South Wales, the DSC only identifies accountability for 18 privately owned dams (NSW DSC, 2011). Unfortunately the Dams Safety Act (1978) does not appear to provide for an adequate register of all dams (including small ones) in the state, nor does it provide for an adequate budget to enable the DSC to supervise more dams than are already prescribed (Pisaniello, 2011). Hence, there is no accountability for many of the smaller farm dams which may pose significant hazard individually or cumulatively.

3.4.2.2 Queensland

In Queensland, under the Water Act (2000), there are hazard ratings, oversight and accountability acknowledged for 46 'referable' dams. However, only three of these dams are privately owned dams (Water Act (2000), Schedule 12), the type under investigation by this review of the farm dam management institutional environment.

3.4.2.3 Victoria

In the farm dam management institutional environment of Victoria, farm dam safety is monitored by the two rural water corporations that provide the bulk of irrigation dam, and stock and domestic dam, oversight: Goulburn Murray Rural Water and Southern Rural Water (DSE, 2011). Goulburn Murray Rural Water identifies accountability for 200 farm dams for safety purposes (G-MW, 2006) and Southern Rural Water is accountable for approximately 400 farm dams (Parker, 2011, pers. comm. 4 May).

3.4.2.4 Tasmania

Tasmania's institutional environment exhibits the most accountability for farm dam management, imposing some form of accountability for *all* dam storages (Pisaniello, 2010; 2011; Tingey-Holyoak *et al.*, 2011). This means that in Tasmania, there is accountability for as many as 8,000 dams for safety which is up to 100% of the farm dam population of the small state.

3.4.2.5 Summary

The spectrum of accountability in the institutional environment of sustainable farm dam management is presented in the discussion of the four states above. The discussion is represented visually in Table 3.3 which provides overview of accountability for equity and safety monitoring in each state and territory in Australia. This overview also allows for the development of a measure based on the percentage of dams in a state or territory

captured by sustainable farm dam institutional mechanisms, highlighting a trend of increasing accountability.

Table 3.3 – Accountability for equity and safety monitoring in Australia

Mechanism of institutional environment	Australian Capital Territory	South Australia	Queensland	New South Wales	Victoria	Tasmania
Number of dams currently captured by safety mechanisms	0	0	3	18	600	8,000
Number of dams captured by non-regulatory institutional actors	0	0	0	0	0	0
Total dams in state	1,000	38,000	6,400	300,000	300,000	8,000
% of dams in state captured by sustainable farm dam institutional mechanisms	0.00%	0.00%	0.00%	0.01%	0.20%	100.00%

Increasing accountability for farm dams

3.4.3 Accountability for equity and safety of small dams

Small farm dams will not always pose an impact or threat to the equitable sharing and safe storage of water on an individual basis. However, because of potential cumulative impacts and threats, even small, low hazard dams would be registered and supervised in a strong institutional environment (see Chapter 2, Sections 2.3.2.1 and 2.3.2.2 for discussion of the impact of small dams on both drought and flood). The following sections consider the institutional environment of each state and territory remaining in the analysis from both an equity and safety perspective.

3.4.3.1 The Australian Capital Territory

The ACT has equity mechanisms which capture 'new' dam applications as low as 2ML (Water Resources Act (2007)). Unfortunately, existing dams escape this strict criteria. The Australian Capital Territory has no specific safety mechanisms in the sustainable farm dam institutional environment (ANCOLD, 2011b).

3.4.3.2 South Australia

South Australia is endeavouring to be 'strong' with equity mechanisms in the sustainable farm dam management institutional environment, however there is still little accountability for small or stock and domestic farm dams which can withhold significant water from the environment (NWC, 2011). Exact size criterion of dams monitored are absent from all plans as the pressures are placed on irrigation usage only. South Australia is absent from

safety mechanisms, further reducing any potential accountability for anything other than the equity of 'large' irrigation dams (ABC, 2011).

3.4.3.3 New South Wales

In the sustainable farm dam management institutional environment of New South Wales, dam owners are required to have a license for water sharing if they take more than their harvestable right, which is more than 10% of the average regional rainfall run-off from their property (NSW OOW, 2010). Because there is no integration of the water storage equity and safety environments, small dams would not come to the attention of the relevant body unless they were obviously posing a hazard and had been reported by a member of the community. Dams are only 'prescribed' on the recommendation of the Dam Safety Committee, and this is normally when greater than 15m in height or smaller with high or significant hazard rating (NSW DSC, 2012). In general, dams with a wall height of less than 5m are only prescribed if a high hazard potential is posed (NSW DSC, 2011).

3.4.3.4 Queensland

From an equity perspective, Queensland has various plans in the sustainable farm dam management institutional environment that monitor fair water sharing from irrigation and commercial storages as small as 5ML (DERM, 2012). However, from the safety perspective, Queensland only addresses the problems associated with hazardous very large, 'referable' dams that are over 8m or 250ML (Water Supply (Safety and Reliability) Act (2008)). The institutional environment does not place pressure on smaller, privately owned farm dams. The problems associated with these small dams can still create unfair water sharing and safety risk at the individual and cumulative levels (Pisaniello & McKay, 2005; Pisaniello *et al.,* 2011a).

3.4.3.5 Victoria

As highlighted in Section 3.4.1.7, the farm dam institutional environment of Victoria has become stronger since the amendments to the Water Act in 2002 (Water Act (1989) Incorporating the Water (Irrigation Farm Dams) Act (2002)), through improved integration of policy, increased site inspections, and increased focus on environmental requirements (DSE, 2007). Safety is integrated into equity policy and operating licenses have requirements upon them to include aspects such as ongoing surveillance and maintenance (for a detailed review see Pisaniello, 2011; Pisaniello *et al.*, 2011b). Despite obviously highly integrated policy, such 'Take and Use' licenses are only imposed on irrigation and commercial users, and operating licences for safety only upon owners of potentially

hazardous 'referable dams' (DSE, 2007). Referable dams includes those which have a wall height greater than 5m and at least 50ML storage capacity or those with a wall height greater than 10m and at least 20ML capacity (or over 15m in height of significant hazard) (DSE, 2007; Pisaniello, 2009). This size-based approach omits many farm dams, often much smaller than the above size criterion, that individually may pose no threat to their immediate downstream area but nonetheless may have a significant cumulative threat within a catchment if not managed sustainably.

3.4.3.6 Tasmania

Tasmania is the only State in Australia to acknowledge that, because of potential cascade/cumulative threats, even small, low hazard dams must be registered and supervised (DPIW, 2008). Tasmanian policy (Water Management (Safety of Dams) Regulations (2003)) imposes some form of dam safety management accountability upon the owners of all dam storages as small as 1ML (see Pisaniello, 2011 for detailed analysis).

3.4.3.7 Summary

The above review reveals varying strengths of accountability for equity and safety of small dams in the institutional environment of Australia. Table 3.4 develops a summary of the accountability for small dams in the institutional environments in the states and territories of Australia, also highlighting a trend of increasing accountability for small dams.

Table 3.4 – Accountability for equity and safety of small dams in Australia

Mechanism of institutional environment	Australian Capital Territory	South Australia	Queensland	New South Wales	Victoria	Tasmania
Size captured for equity	≥2ML	'Large'*	Variable 5ML-250ML	'Harvestable right'	Irrigation all	≥1ML
Size captured for safety	×	×	>8m+ 500ML or >8m+ 250ML or catchment area> 3x max surface area at full supply level	15m or smaller if hazard to life/property/ environment	≥5m + 50ML or ≥10m + 20ML or ≥15m	≥1ML
Summary state comparison for capturing EXISTING small farm dams	Absent	Limited	Limited	Moderate	Strong	Very strong

Increasing accountability for small dams

*Larger commercial and irrigation users only (ANRA, 2009a), for example in the high concentration area of Mt Lofty Ranges with its plan in the final stages, will only focus on reporting from '2000 *large* irrigation dams' (ABC, 2011).

3.4.4 Equity and safety reporting

Reporting of equitable and safe water storage can play a vital role in facilitating sustainable farm dam management processes and decisions for farmers and other institutional actors. This element of the institutional environment facilitates assessments of water allocations and ongoing storage safety. The element of reporting sustainable farm dam information as an important part of the institutional environment is discussed for each remaining state and territory in the following sections.

3.4.4.1 The Australian Capital Territory

In the sustainable farm dam management institutional environment of the Australian Capital Territory, the Water Resources Act (2007) is the legal basis for controlling all water use and interception activities. Unlicensed farm dams are identified by the plan 'Think Water, Act Water' (Environment ACT, 2004). However, only the installation of *new* farm dams is regulated (NWC ACT, 2012). There are no clear reporting mechanisms for the impact of existing farm dams, especially small dams, at this stage (NWC ACT, 2012). As highlighted in Section, 3.4.3.1 the institutional environment is safety mechanism absent so no reporting of farm dam safety is required.

3.4.4.2 South Australia

In South Australia, interest in the health of catchments surrounding the Murray-Darling basin has meant that a conservative regime of water allocations within a relatively strong water reporting policy was established early (Clark, 1971; Crase, 2008). Lower limits and stricter controls on new and existing dams occur in prescribed areas of the State and metering within some of these areas, however only for irrigation or stock intensive use – stock and domestic use is largely unregulated and does not require reporting (Water Resources Act (1997)). This is in spite of the obvious problem of allowing unregulated small dams, often designed for stock and domestic use, to draw unreported as much water from the system as required. However, despite South Australia being quite strong with their assessment of the risk of relevant interception activities, such as irrigation farm dams, there is still an absence of comprehensive metering and reporting under the water allocation plans, although reporting and evaluation is specified for the future (NWC SA, 2012).

From a safety perspective, South Australia is a policy-absent state because there are no statutory provisions to ensure adequate ongoing supervision of potentially hazardous private dams (see Pisaniello *et al.*, 2011a). Despite the regional NRM Boards having some control over farm dams in respect to their storage capacity, their focus is only on water

allocations. The South Australian Government could have included dam safety assurance into its water laws when it developed the NRM Act (2004), yet the dam safety issue is still not considered critical by policy makers as integration of equity and safety policy was not executed at this opportune time (Pisaniello, 2011).

3.4.4.3 New South Wales

In New South Wales the focus in the farm dam institutional environment has historically been on allocation of all available resources rather than conservation and reporting (Crase, 2008). However, following the COAG water reform agreement there were notable reforms by New South Wales. As established in Section 3.4.1.5, no license is required to take and use water from a farm dam that can capture up to 10% of the average regional rainfall runoff for an individual property (NSW OOW, 2010). The use of a simple percentage-based equation that can be easily calculated on the Office of Water's website (see NSW OOW, 2010) allows for identification and capture of high users for any purpose (stock and domestic *and* irrigation) and reporting of that use if the amount exceeds the extraction limit set in a prescribed area. If a farmer's estimation is over their 'harvestable right' then they need a license which will need to be metered and reported on (Water Management Act, 2000; O'Connor & MacDonald, 2002). Again, in NSW, metering is sporadic and inconsistent although progressing rapidly (NWC, 2011). On the safety side, those dams that are monitored require regular reporting by their owner and random checks by the DSC (NSW DSC, 2011). A full surveillance report is due every five years, and a safety review every 15-20 years unless either of these are required sooner (NSW DSC, 2011).

3.4.4.4 Queensland

In Queensland there are no meters required for existing dams under any water allocation plan except for in Lower Balonne which is a special case where the water resource plan requires the licensing of overland flow take and its metering/reporting (DERM, 2008). In addition, only very few, very large dams are regulated for reporting of safety and those require failure impact assessments carried out in accordance with the department's Guidelines for Failure Impact Assessment of Water Dams (DERM, 2010). Those few owner/managers required to report, need Surveillance Reports and evaluation is conducted as part of a periodic dam safety inspection (at five yearly intervals), although evaluation may be undertaken at more frequent intervals or at times of concern. Following evaluation, a Surveillance Report is required to be prepared by experienced dam engineers familiar with the entire history of the dam (DERM, 2010).

3.4.4.5 Victoria

In Victoria, an amendment to the Water Act (1989) Incorporating the Water (Irrigation Farm Dams) Act (2002) in 2009 meant that all *new* irrigation/commercial dams must be metered and reported on (regardless of size). In addition, where an existing license is being *reviewed* or *amended* then installation of a water meter and subsequent reporting of metering data is required for an existing take and use licence for large irrigation farm dams with an entitlement of greater than 10ML (Water Act (1989) Incorporating the Water (Irrigation Farm Dams) Act (2002)). Domestic and stock use from farm dams is not metered and therefore does not need to be reported.

The rural water corporations enforce the metering and reporting. For example, Southern Rural Water has required metering and reporting of new licenses since 2002, and at the time of writing there are approximately 1,000 farmers reporting their irrigation and commercial use from meters in the region (SRW, 2009; 2011). The other regional water corporation with accountability for farm dams, Goulburn-Murray Rural Water, requires reporting from any new irrigation and commercial dams and any other dams that they prescribe at their discretion (GM-W, 2011). For the fully integrated safety regulations, the Act requires owners to prepare an Emergency Action Plan and Surveillance program for dams over a wall height of 5m and storage capacity of 50ML, or over 10m and 20ML or just a wall height of 15m or more (DSE, 2007). The operating license to operate a farm dam over this size criterion are only valid for 5 years, and when due for renewal there is a need to report an updated Surveillance Report and Emergency Management Plan (SRW, 2012).

3.4.4.6 Tasmania

Although the water equity planning is advanced in the institutional environment in Tasmania, for equity transparency farm dams will only require metering and reporting if water is for irrigation or commercial use (Water Management Regulations (1999)). The farm dam metering program requires reporting from *new* irrigation and commercial use dam applications but is expected to be rolled out completely to encompass *existing* irrigation and commercial users within three years from the time of writing (DPIPWE, 2012). This will be regularly audited in conjunction with the safety requirements (Water Management Act (1999)). As previously highlighted in section 3.4.3.6, Tasmania is the only State in Australia to acknowledge that, because of the potential cumulative impacts to the environment and threats to community safety, even small, low hazard dams must be registered and supervised.

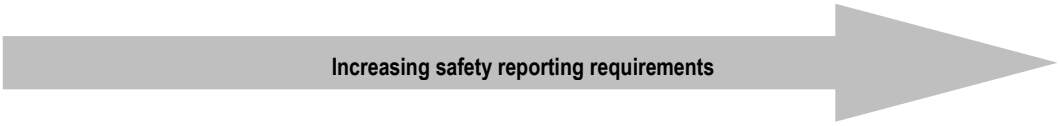
Tasmanian policy (Water Management (Safety of Dams) Regulations (2003)) requires dam owners to report as a condition of their operating permit or as requested by the Minister (Pisaniello, 2009; Pisaniello *et al.,* 2011b). The regulations provide prescribed standards for surveillance and reporting of dams (Pisaniello, 2009) based on the height and hazard category of the dam. For example, owners of significant to high hazard dams must arrange safety inspections and reports by an experienced dam engineer after the initial filling of the reservoir and generally every five years during the life of the dam (ANCOLD, 2000b). The frequency and thoroughness of surveillance reporting and review must comply with ANCOLD Guidelines (ANCOLD, 2003) and there may also be the requirement for emergency action plans (Pisaniello & McKay, 1998). Pisaniello and McKay (1998) determine that these reporting guidelines are generally in line with international best-practice. Because many of the 8,000 dams monitored in Tasmania are small farm dams, to avoid placing significant cost on owners, smaller dams with lower hazard potential do not require full surveillance reports and farmers are able to prepare the report with a guided pro-forma from the department (Pisaniello *et al.*, 2011b).

3.4.4.7 Summary

The above summary of the equity and safety reporting mechanisms in the sustainable farm dam management institutional environment in Australian states and territories provides overview of the reporting processes and decisions for farmers. Table 3.5 provides visual overview of the above review and also development of a measure based on the number of reports required per year on average which allows for development of a spectrum of weak to strong reporting requirements across the states and territories in Australia.

Table 3.5 – Farm dam management reporting under regulatory or other institutional farm dam sustainability mechanisms in Australia

Mechanism of institutional environment	Australian Capital Territory	South Australia	Queensland	New South Wales	Victoria	Tasmania
Equity reporting for farm dams	In development	In development	In development	In development	In development	In development
Safety reporting for farm dams	×	×	5 year	5 year	5 year	5 year
Number of farm dams required to report	0	0	3	18	600	8,000
Number of reports required per year on average	0	0	0.6	3.6	120	1,600



3.4.5 Non-governmental institutional actors' involvement in sustainable farm dam management

The state-based professional farming bodies are relatively silent on farm dams, except when attention to water licensing and allocations creates unrest amongst their members. For example, in South Australia, this attention has meant proposals from the Mount Lofty Ranges Natural Resources Management (NRM) Board for reporting of farm dam issues have been repeatedly altered and put on hold in an attempt to appease community unrest (Littlely, 2011). The peak professional body, the South Australian Farmers' Federation (SAFF), have been vocal in their disdain for any kind of monitoring of farmers with their dams (news.com.au, 2011). Environmental and community groups also make room to comment on any regulation concerning farm dams and provide communication with farmers on matters concerning the environment. For example, the Environmental Protection Association of South Australia provides background material for farmers to manage their dam in a way that does not damage the environment (EPA SA, 2005).

The Victorian Farmers' Federation has been extremely involved in ongoing equity and safety policy development and has information on any new farm dam issues with frequent media releases on any policy proposed (VFF, 2010). However, the New South Wales farming industry bodies, including the New South Wales Farmer's Association (NSWFA), community and environmental groups have been less vocal, possibly because of the perceived equity of the laws with the allocation of an amount to the environment across all farmers (see Section 3.4.3.3 for discussion of the 'harvestable right' in New South Wales).

Although the Tasmanian Farmers and Grazier's Association (TFGA) and financial providers and the media have not released significant information on their position on farm dams, the legislative controls highlighted above reflect tightened integrated safety and equity laws to ensure the sustainability of dams. As highlighted, the State represents the maximum strength of integrated equity and safety mechanisms for sustainable farm dam management accountability.

3.4.6 Summary of equity and safety institutional mechanisms in the environment of farmers managing farm dams

The above review suggests there is considerable difference between the farm dam management institutional environments of the states and territories of Australia. The four farm dam sustainability management institutional environment elements, captured from prior studies in the area, enable ranking of the states and territories trending from weak to very strong. The result of the review of the content of regulations and the integration of

equity and safety mechanisms, accountability for equity and safety monitoring, accountability for equity and safety of small dams, and equity and safety reporting highlights that Tasmania clearly leads the other states in strength of institutional environment. All of the criteria are met by the state and thus is considered best practice from the review. Table 3.6 summarises the reviews of all of the states according to the sustainable farm dam management institutional environment elements identified.

Table 3.6 – Equity and safety mechanisms of the institutional environment of sustainable farm dam management practice in Australia

Mechanism	Australian Capital Territory	South Australia	Queensland	New South Wales	Victoria	Tasmania
Content and integration	×	×	✓	×	✓	✓
Accountability for farm dams – % monitored	0.00%	0.00%	0.00%	0.01%	0.20%	100.00%
Capturing of existing small farm dams	Absent	Limited	Limited	Moderate	Strong	Very strong
Number of reports required per year on average	0	0	0.6	3.6	120	1,600
Strength of institutional environment*	**WEAK**	**WEAK**	**MODERATE**	**MODERATE**	**STRONG**	**VERY STRONG**



*Measure determined objectively based on above review of policy, internet-based data, and literature.

3.5 Summary

The review of the sustainable farm dam management institutional environment, performed mainly on historical, archived, and internet-based documents, in addition to the prior literature, provided a map of the formal and informal equity and safety mechanisms in place. The analysis of the four components of content and integration, accountability monitoring, accountability for small dams, and equity and safety reporting, facilitated identification of jurisdictions that represent a trend from weak farm dam institutional environments to very strong farm dam institutional environments.

As incomplete as some of the information was, especially as it relates to equity mechanisms for sustainable management of existing small dams, the reviewed policy and literature in this chapter provides understanding of the institutional environment of sustainable farm dam management in Australia, addressing Research Problem 2 by improving understanding of the equity and safety mechanisms in the institutional

environments of farmers managing farm dams. Thereby the chapter answers sub-Research Question 2: *What are the equity and safety mechanisms in the institutional environment of farmers managing farm dams?*

The following chapter will present and build upon Oliver's (1991) full model in order to generate a series of variables and hypotheses for empirical testing and development of the framework. The review of the equity and safety mechanisms in the sustainable farm dam management institutional environments presented in this chapter will facilitate understanding of the context and setting for modelling of the moderating variable of 'Institutional Environment' in Chapter 4, and subsequent choice of test states in the Design and Methods of Chapter 5.

Chapter 4

Institutional pressures that can cause a sustainable farm dam management response from farmers

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4.1 Introduction

The main outcome of Chapter 2 was an introduction to the area of farm dam sustainability and sustainable management and presentation of a background review of institutional theory, resource dependence theory, and their amalgamation in the framework adopted by this study (Oliver, 1991). Chapter 3 then presented a review of the sustainable farm dam management institutional environment in order to provide understanding of the equity and safety mechanisms in the environment of farmers managing farm dams (Research Problem 1).

Now Chapter 4 is designed to investigate the institutional pressures that can cause a sustainable farm dam management response from farmers by funnelling the broad background concepts and notions identified in Chapter 2 and 3 into a theoretical and conceptual framework. This framework enables development of a series of testable hypotheses formed from the literature and model. Importantly, the chapter applies institutional and resource dependence theories at the individual farmer level, as a representative of the organisation, to address the lack of understanding of the institutional pressures that can cause a sustainable farm dam management response from farmers, thereby seeking to find answers to sub-Research Question 2, *What are the institutional pressures that can cause a sustainable management response from farmers?*

This chapter builds upon the foundations of Chapter 2 and moves toward filling the gap in the understanding of sustainable farm dam management resistance to institutional pressure. Oliver's (1991) complete strategic response typology, briefly introduced in Chapter 2, is used to develop a model of institutional antecedents of the predicted sustainable farm dam management response. The strategic response type (dependent variable) and institutional antecedents (independent variables) will be discussed in this context. The chapter also presents the important moderating variable of Institutional Environment developed from the institutional environment review in Chapter 3. The outcome of this chapter will be a theoretical and conceptual model of farmer strategic responses to institutional pressures and development of empirically testable hypotheses which are presented in the following sections.

4.2 Strategic responses to institutional pressures

One of the major criticisms of institutional theory is its failure to address strategic behaviour (DiMaggio, 1988; Oliver, 1991; Ingram & Simons, 1995; Scott, 2001). Oliver's (1991) influential modelling combines institutional theory with resource dependence theory in order to develop a strategic response typology. As a result of resource dependence theory's complimentary focus on the benefits of noncompliance in response to external demands (Pfeffer & Salancik, 1978) the subsequent modelling with institutional theory allows for identification of a repertoire of alternative strategies that organisations can take when faced with pressure to manage in a certain way. Oliver (1991) identifies five strategies available to organisations when faced with institutional pressures that can describe their responses in order of least resistant to pressure to most resistant: *acquiescence, compromise, avoidance, defiance,* and *manipulation*. Table 4.1 places the strategic response typology in the context of sustainable farm dam management and each is discussed separately in the following sections.

Table 4.1 - Available strategic responses (Dependent Variable) to institutional pressures

Increasing RESISTANCE to institutional pressure: LOW → HIGH

Strategic Response	Example	Interpretation for this research
Acquiescence	Following invisible, taken for granted norms Mimicking institutional models Obeying rules and accepting norms (Oliver, 1991, p.152; Clemens & Douglas, 2005, p.1206).	Farmers decide to follow the sustainable farm dam management rules and norms of the local and state and federal requirements (Pisaniello *et al.,* 2011b; Pisaniello *et al.,* 2012).
Compromise	Balancing the expectations of multiple constituents Placating and accommodating institutional elements Negotiating with institutional stakeholders (Oliver, 1991, p.152; Clemens & Douglas, 2005, p.1206).	Farmers negotiate with their regulators to obtain mutually agreeable solutions that meet the intent of the sustainable farm dam management social and environmental rules and norms at a reduced cost to the farmer (Pisaniello *et al.,* 2011b; Pisaniello *et al.,* 2012).
Avoidance	Disguising nonconformity Loosening institutional attachments Changing goals, activities, or domains (Oliver, 1991, p.152; Clemens & Douglas, 2005, p.1206).	Farmers decide that the possibility or cost of responding to the sustainable farm dam management social and environmental rules and norms is not worth the cost. The farmer does not upgrade/maintain/unblock their spillway to avoid cumulative inequity or failure (Pisaniello *et al.,* 2011b; Pisaniello *et al.,* 2012).
Defiance	Ignoring explicit norms and values Contesting rules and requirements Assaulting the sources of institutional pressure (Oliver, 1991, p.152; Clemens & Douglas, 2005, p.1206).	Farmers decide that the institutional environment does not have the resources or political force to enforce the sustainable farm dam management rules and norms. Firms deal with institutional actors through the courts and legal system (Pisaniello *et al*., 2011b; Pisaniello *et al.,* 2012).
Manipulation	Importing influential constituents Shaping values and criteria Dominating institutional constituents and processes (Oliver, 1991, p.152; Clemens & Douglas, 2005, p.1206).	Farmers try to influence the sustainable farm dam management rules and norms. This may be done in an open matter directly with institutional actors (Pisaniello *et al.,* 2011b; Pisaniello *et al*., 2012).

4.2.1 Acquiescence

Acquiescence can also be termed simply 'conformity' as it describes the response that is low in resistance to the regulatory, normative and cultural-cognitive pillars of institutional theory. This is the response that institutional theorists have focused on most (Scott, 2001) with organisations acquiescing in fear of heavy penalties from regulators or for greater access to clients or reward. At times farmers would respond with low resistance (that is, acquiesce) to change efforts and such a response can take different forms. The form of *habitation* indicates a possible unawareness of institutional pressures as they are so taken for granted that an organisation cannot respond to them strategically (Oliver, 1991; Clemens & Douglas, 2005). A manager may undertake an *imitation* form of acquiescence that refers to 'conscious or unconscious mimicry' of other successful farmers around them, in line with mimetic isomorphism (Oliver, 1991, p.152) and this action can result in them being exposed to public or financial sanctions (Bansal, 2005). A manager would assume a *compliance* form of acquiescence if a conscious decision was made to incorporate the pressure into the management response in order to gain anticipated benefits (Oliver, 1991) such as reduced fines from sustainable farm dam management regulations or rules, or reduced pressure from neighbours downstream.

4.2.2 Compromise

Alternatively, farmers may take a slightly higher resistance to institutional pressure and *compromise* which is the most likely response when there are multiple conflicting priorities from the institutional environment and a desire to promote self-interest, but there is still intent to conform to institutional rules, norms and values (Oliver, 1991). D'Aunno *et al.* (1991) find empirical evidence of compromise and findings suggest that organisations will sometimes be in situations where pressure from the institutional environment means they can have room to bargain, negotiate and compromise. The ability for organisations to compromise was also tested further by Alexander (1996) who, through analysis of curators of US art museums, finds that organisations that are more dependent on compliance are more likely to rely less on compromise, compared with those who are more independent from the field. Where inconsistencies exist between institutional expectations and the objectives of the farmer, the farmer is likely to try to balance the needs and demands of multiple constituents whilst also serving internal interests (for example, Powell & Friedkin, 1986). Balancing expectations within an acquiescent strategy is particularly challenging when external expectations are conflicting, such as in the case of demands on farmers to provide enough water for downstream communities but also to meet the needs of environmental groups who demand more water for the environment. Farmers may also try

to pacify external demands by meeting the minimum standard to placate pressure sources (Oliver, 1991), such as carefully monitoring regulatory field officer goals and making minor adjustments to achieve parity between regulator goals and those of other stakeholders. More actively, a farmer may bargain and negotiate in an effort to benefit from a concession (Oliver, 1991).

4.2.3 Avoidance

Oliver (1991) defines *avoidance* as attempts to conceal or buffer undesirable parts of organisational activities from institutional pressures to conform. Avoidance has also been referred to as 'decoupling' by institutional theorists (Meyer & Rowan, 1977), that is, the separation of structural features from technical activities (Scott, 2001). Similarly, 'loose coupling', with institutional rules and norms, which happens in many organisations, is a weak form of avoidance (Orton & Weick, 1990). Scott (2001) suggests that avoidance is more likely to occur when an organisation is confronted with regulatory pressure, rather than with normative or cultural-cognitive demands. To achieve avoidance, farmers may use a number of tactics. A farmer may endeavour to conceal unsustainable dam management and be non-compliant with pressures (Oliver, 1991; Clemens & Douglas, 2005), for example, sending engineering plans to regulators to conform to the requirement of an increased spillway capability and then not undertaking the enlargement works. An organisation may also buffer pressure in an attempt to reduce external inspections or assessments or decoupling activities from inspectors or investigators (Pfeffer & Salancik, 1978; Scott, 1987) such as removal of debris accumulated in a spillway (Pisaniello & McKay, 2007) from poor dam management practice just prior to inspection, only to let it accumulate again until the next inspection. At the strongest end of the avoidance strategy, an organisation, or in this case a farmer, may leave an institutional or organisational field in order to avoid succumbing to institutional pressures placed on them in the field (Oliver, 1991).

4.2.4 Defiance

Farmers could also choose to ignore institutional rules and norms which challenge their existing farm dam management practices. Oliver (1991) defines *defiance* as a form of public resistance of an organisation to pressure that occurs when the organisational behaviour and standard operations differ dramatically from the regulations or pressures that are being forced up them. Defiance is higher in resistance than avoidance as it involves an overt response that is more likely to occur if the nature of the pressure differs from the normative and cultural-cognitive goals of the organisation (Scott, 2001). Dismissing institutional pressure can be a form of a defiance strategy that occurs when

comprehension of the pressure is low or the rationale behind the pressure poorly communicated (Oliver, 1991). A farmer may also challenge the institutional pressure in a public contest of the rationality of the pressure (Oliver, 1991), such as farmers protesting water allocation laws at a community meeting in a region where the farmers perceive they have unparalleled knowledge of the rainfall and land use patterns. Attacking is the strongest dimension of a defiance response and can include aggression and intensity, or even assault (Oliver, 1991).

4.2.5 Manipulation

Ultimately, a farmer could even go further to challenge the content of the sustainable farm dam management regulatory and normative expectations upon them through the most resistive of strategies: *Manipulation*. Manipulation can be defined as a purposive attempt to control the pressures from the environment and is the most highly resistant response to institutional pressure (Oliver, 1991). It is an attempt to control the environment in a way that ensures the organisation's interests are primary and pressure is neutralised. A farmer may co-opt to the institutional pressure if they believe it is possible to influence or control part of the pressure. For example, a farmer may endeavour to secure a position on a natural resource management board to try and influence the policy setting process. Under a manipulative strategic response, a farmer may even attempt to influence perceptions through lobbying or political process that can result in the reinterpretation and ultimate manipulation of pressures (Oliver, 1991). For an organisation wishing to attempt to dominate a smaller group rather than an institutionally powerful pressure generator they can attempt to control the pressure (Oliver, 1991; Clemens & Douglas, 2005). This is most successful when 'institutional expectations are incipient, localized, or weakly promoted', (Oliver, 1991, p.158). Despite the plausibility that an organisation would attempt to influence regulators or dominate institutional values and criteria, two of the major studies that have tested Oliver's framework have not included manipulation (Goodstein, 1994; Ingram & Simons, 1995) and a third had findings that allowed for the combination of compromise and manipulation (Etherington & Richardson, 1994). This research has kept the fifth typology of a manipulation response because it is distinctly able to be applied to the study problem: it is just as likely that a farmer would openly try to influence and change regulations through politicians and regulators, as they would negotiate with them to try and obtain a mutually agreeable solution at a reduced cost to the farmer.

4.2.6 Dependent Variable (DV): Sustainable farm dam management strategic response

Literature in Chapter 2 highlighting the critical problem of unsustainable farm dam management provides the foundation for a dependent variable of the study that includes a

comprehensive measure across all components of a response to institutional pressure to manage farm dams sustainably. As presented above, the types of strategic responses possible to any institutional pressures range from a low resistance response (acquiescence and compromise) to a moderately resistant response (avoidance) through to a strongly high resistance response (defiance or manipulation). This range of the dependent variable is constructed for this research to measure the response of 'resistance' to institutional pressure (Oliver, 1991, Clemens & Douglas, 2005) in order to investigate different organisational response to institutional expectations when faced with problems of legitimacy, questions of institutional status, political self-interest and resource scarcity. Although Oliver (1991) does not explicitly term the scope of possible responses as a scope of 'resistance', it is assumed for this research that there is a range of low to high resistance in response to institutional pressures, and this notion of resistance is also considered by some authors to be implicit in Oliver's work (Etherington & Richardson, 1994). The strength of 'resistance' will provide a measure for the dependent variable and it is noted by the research that low resistance is not inevitable or instrumental to sustainable farm dam management. However the fact that farmers will not invariably conform to rules, myths or expectations in their institutional environment is important and under which conditions the pressure from these rules, myths and norms fail, is critical to understanding sustainable farm dam management.

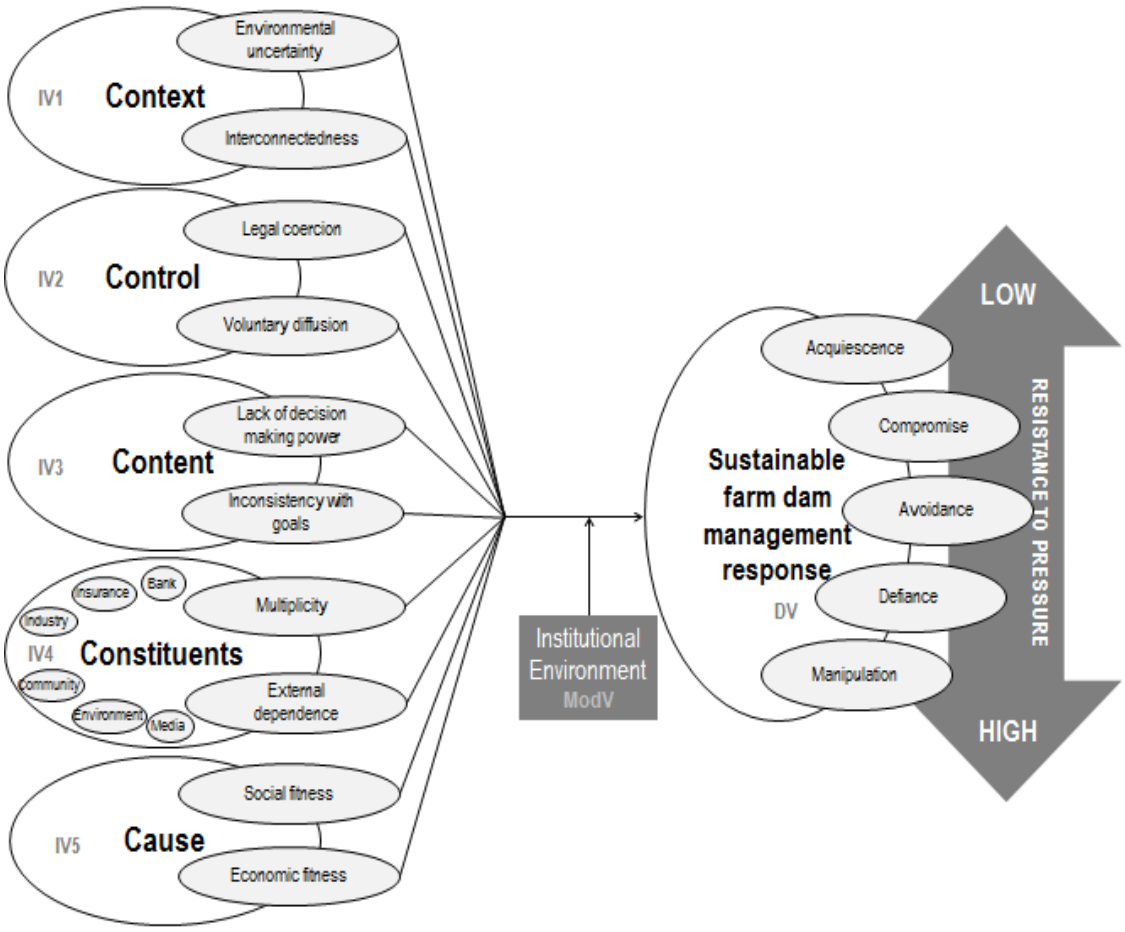
Thus, the following sections will discuss further the institutional antecedents of a strategic response to sustainable farm dam management pressure and present independent variables that predict the aforementioned possible responses, and subsequent hypotheses for further empirical testing in Chapter 6.

4.3 Predictors of strategic responses

As discussed in Section 4.2, Oliver (1991) modelled strategic responses to institutional pressure and labelled the responses from *Acquiescence* to *Manipulation* on a spectrum of low to high resistance, with a low resistance strategy being the most likely to accede to institutional pressure to undertake a behaviour in question, in this case sustainable farm dam management. Within the model of strategic responses, Oliver (1991) also presented possible predictors of these strategic responses. The model included changes in conformity and variation of resistance dependent on (1) where the pressures occur, (2) how the pressures are being exerted, (3) what the pressures are, (4) who is exerting the pressures, and (5) why the pressures are being exerted (Oliver, 1991, p.159). The five institutional predictors of strategic responses, *context, control, content, constituents* and

cause correspond to the five basic questions above presented by Oliver. Furthermore, each antecedent has two dimensions, to determine choice of strategy, as illustrated in Figure 4.1. However, this research furthers Oliver's (1991) model (and all other iterations of the model to the best of the author's knowledge) by collapsing out the constituents' predictor to individually model each institutional constituent's demands on farmers for sustainable farm dam management (Figure 4.1). By this the research is able to capture the pressure on farmers to manage farm dams sustainably from banks, insurers, farming industry bodies, community groups, environmental groups and the media. In addition the model includes the location of the farmer, or the farmer's 'Institutional Environment', as developed in Chapter 3, which will be a moderating factor in the relationship between each independent variable and the dependent variable (Figure 4.1).

Figure 4.1 – Sustainable farm dam management response to institutional pressures: The theoretical and conceptual model used in this study



Variation in strength of resistance to institutional pressure can then be modelled based on each individual antecedent (Table 4.2). For example, from Table 4.2 *manipulation* (a highly

resistant response) is most likely to occur as a result of the 'content' antecedent (IV3) when institutional rules and norms are not consistent with the goals of the farmer (that is, 'Inconsistency with goals' is high).

Table 4.2 - Predicted dependent variable responses based on independent variables

(Oliver, 1991)



Independent Variable (IV)	Strategic Response Type (DV)				
	Acquiescence	Compromise	Avoidance	Defiance	Manipulation
IV1 Context					
IV1a Uncertainty	High	High	High	Low	Low
IV1b Interconnectedness	High	High	Moderate	Low	Low
IV2 Control					
IV2a Legal coercion	High	Moderate	Moderate	Low	Low
IV2b Voluntary diffusion	High	High	Moderate	Low	Low
IV3 Content					
IV3a Lack of decision making power	Low	Moderate	High	High	High
IV3b inconsistency with goals	High	Moderate	Moderate	Low	Low
IV4 Constituents					
IV4a Multiplicity	Low	High	High	High	High
IV4b External dependence	High	High	Moderate	Low	Low
IV5 Cause					
IV5a Legitimacy	High	Low	Low	Low	Low
IV5b Efficiency	High	Low	Low	Low	Low

The individual institutional antecedents place boundaries on the preparedness of organisations to respond with low resistance to institutional pressure (Etherington & Richardson, 1994). Oliver (1991) hypothesised that high resistance, to institutional pressure is greater when: (1) uncertainty is low and interconnectedness between an organisation's goals and those organisations exerting the pressure is limited (context), (2) there is a low amount of legal coercion and not many organisations in the field are undertaking the activity being pressured to undertake (control), (3) there is limited consistency with the organisation's goals and discretion and lack of decision making power is high (content), (4) there are many conflicting demands from multiple constituents and there is not a lot of dependence on them (constituents), and (5) opportunities for social legitimacy and economic gain are limited (cause). These relationships between the strength of resistance and the individual institutional antecedents are discussed further and

ultimately developed into testable hypotheses in the following sections which present each variable in turn.

4.4 Independent Variable 1 (IV1): Context

The context of the environment in which the farmer operates is important because some institutional fields are better settings for compliance than others (Ingram & Simons, 1995). In their study of responsiveness to work-family issues in the USA, Ingram and Simons (1995, p.1470) find that context such as 'relational density, history, and trade associations' can make organisations more observant of other organisations' practices in order to change their own. An organisations environment can be context specific and the extent of its environmental uncertainty and interconnectedness will shape its response to pressure (Oliver, 1991; Goodstein, 1994). The literature presented in Chapter 2 includes discussion of the institutional environment of farmers as they face water storage pressures from agricultural demands (Section 2.2.1), climate change pressures (Section 2.2.2) and regulatory pressures (Section 2.4). Therefore, there is a need to test strategic response to manage farm dams sustainably in light of the context within which an institutional pressure acts on the firm as a predictor of the firm's response to the influence. These two main ways that context affects an organisation's strategic response to institutional pressure will be discussed as follows.

4.4.1 Environmental uncertainty (IV1a)

Environmental uncertainty is the extent to which the future cannot be accurately predicted (Pfeffer & Salancik, 1978). When an environment is uncertain, the organisation will exert control to try to establish certainty. Institutional theory predicts that managers will have a preference for stability, certainty and predictability (DiMaggio & Powell, 1983; DiMaggio, 1988; Zucker, 1977). When the environment is unstable or unpredictable and institutional context or dependence on resources is uncertain, then a manager will respond strategically in order to regain control of organisational outcomes (Oliver, 1991). Therefore, a farmer is more likely to acquiesce, compromise and avoid when uncertainty is high because they will be more willing to comply with external demands imposed upon them in an endeavour to protect the organisation (Meyer & Rowan, 1977; Oliver, 1991). A compromise strategy was observed by Pfeffer and Salancik (1978) who suggest that negotiation is a common approach for reducing environmental uncertainty. Avoidance was a commonly occurring strategy in research by Meyer *et al.* (1983, p.58) who found organisations buffering themselves from environmental uncertainty by attempting to 'render [uncertainties]

invisible' in order to regain control. When the uncertainty is overcome, defiance and manipulation (resistant strategies) become less risky options to take in response to pressure (Oliver, 1991). High levels of environmental uncertainty will motivate a farmer to attempt to reduce uncertainty by acquiescing to institutional pressures (Goodstein, 1994) and for sustainable farm dam management this means not only less resistance to efforts of regulators to impose water sharing equity or dam safety regulations to reduce uncertainty of water entitlements or risk of dam failure, but also efforts to mimic other farmers who are having success in an uncertain environment (DiMaggio & Powell, 1983).

Therefore, it is hypothesised that:

> Hypothesis 1a: Perceptions of environmental uncertainty will be negatively related to resistance to sustainable farm dam management pressures.

4.4.2 Interconnectedness (IV1b)

Interconnectedness refers to the dependency of interorganisational relationships in an organisational field (DiMaggio & Powell, 1983) which is a key element of context (Oliver, 1991; Clemens & Douglas, 2005). Managers are more likely to accept institutional pressures when the environment is highly 'connected' as this situation facilitates the diffusion of voluntary behaviours and norms throughout the region (Meyer & Rowan 1977; DiMaggio & Powell, 1983). It is suggested that highly interconnected environments create channels that enable consensus on institutional norms (Meyer & Rowan, 1977; DiMaggio & Powell, 1983; Galaskiewicz, 1991; Goodstein, 1994). Interconnectedness and awareness of other farmers' water storage practices allows a farmer to compare and adjust their standards if necessary. The consensus on the norms gives them power over organisational responses (Powell & DiMaggio, 1991; Oliver, 1991). When there are many constituents in a field such as professional associations and community groups, then the field is more likely to be interconnected which will provide a way for dissemination of institutional norms and behaviours (DiMaggio & Powell, 1983). This is supported by Goodstein who (1994) highlights that institutional environments are more interconnected when organisations participate in community or industry activities as a mechanism for diffusing institutional norms and expectations. Hamel *et al.* (1989) hypothesised that stronger cooperation and relationships would be related to less resistant strategies, relying on their associations, such as industry or community to adopt higher resistance strategies. Farmers are less likely to be resistant to institutional pressures if they are part of an environment of 'relational channels through which institutional norms can be diffused' which is likely to create more coordination and collectedness, even if only on an implicit level (Oliver, 1991,

p.171). These relational channels allow for development and maintenance of 'rational myths' for sustainable farm dam management and are therefore more likely to compromise with, or avoid, institutional pressure rather than if the environment is fragmented or 'purely competitive' (Oliver, 1991, p.171).

Therefore, it is hypothesised that:

> Hypothesis 1b: Perceptions of interconnectedness within the institutional environment will be negatively related to resistance to sustainable farm dam management pressures.

4.5 Independent Variable 2 (IV2): Control

Control in the institutional environment refers to the means by which institutional pressures are imposed on organisations (Oliver, 1991, p.168). The more prescriptive and strong the control environment, the more likely an organisation would less actively resist institutional pressures from the environment. Other authors have also found that legislation for socially and environmentally sustainable behaviour encourages organisational compliance (Bansal & Roth, 2000; Clemens & Douglas, 2005). Because of the prescriptive nature of more regulation, most strategic responses to control pressure will be less resistant. Environmental protection regulation has been found to have 'means' and 'ends' orientations (Tenbrunsel *et al.*, 2000). Means-oriented control pressure has a focus on continuous meeting of a standard, such as farm dam safety five yearly surveillance reports (Pisaniello *et al.*, 2011b), where an organisation is implicitly discouraged from working with regulators to find solutions but simply on compliance with the law. An ends-oriented control pressure has the focus on more efficient improvement encouraging organisations to take more highly resistant strategies that may be in line with their own efficiencies rather than the regulation, such as water trading when inflow into the storage is good, rather than deliberate blocking activity to withhold more than entitlement for future periods. Control has elements of *legal coercion* (such as regulation for sustainable farm dam management, see Chapter 2, Section 2.4.1 for a review of the institutional environment of each test state including the regulatory setting) or *voluntary diffusion* (such as the spread of sustainable farm dam management norms throughout a region or industry) (Oliver, 1991). The two elements of independent variable 2 'control', will be discussed in turn.

4.5.1 Legal coercion (IV2a)

The power of regulators is distinct from voluntary action of the prescribed behaviour (DiMaggio & Powell, 1983; Oliver, 1991). The force of institutional influences such as

explicit government regulation and coercion can demand a firm act in an environmentally and socially responsible fashion (DiMaggio & Powell, 1983; Oliver, 1991; Wood, 1991; Weaver *et al.,* 1999). If *legal coercion* for sustainable farm dam management is high then farmers are more aware of threats for noncompliance and will be less likely to respond defiantly or manipulatively (Oliver, 1991). Often the threat of fines not only results in the fear of economic losses, but also losses of legitimacy (Bansal, 2005). When legal coercion is high and threats are real and potentially severe, then acquiescence is a common response unless the legal requirements are not enforced well and then a compromise strategy will also be usual (Oliver, 1991).

Therefore, it is hypothesised that:

> Hypothesis 2a: Perceptions of sustainable farm dam management legal coercion will be negatively related to resistance to sustainable farm dam management pressures.

4.5.2 Voluntary diffusion (IV2b)

The extent to which a regulated practice is spread throughout a network will predict the success with which the firm strategically responds (Oliver, 1991). Tolbert and Zucker's (1983) seminal longitudinal field studies highlight that later adopters were shown to be responding to pressures in reaction to the perceived legitimacy created by the organisations that were first-movers, highlighting power of *diffusion of practice or policy voluntarily* through a system. This notion is also consistent with the concept of mimetic isomorphism where farmers will be more likely to copy the actions of others if the practice is widely diffused (DiMaggio & Powell, 1983). In the absence of sustainable farm dam regulation, then the primary mechanism for which practice becomes the norm is voluntary diffusion. As organisations adopt these norms they realise increasing legitimacy gains (Fligstein, 1985; Tolbert & Zucker, 1983) and reductions in uncertainty (Pfeffer & Salancik, 1978). The literature suggests conformity to institutional pressures is more likely when norms and expectations have been voluntarily adopted and diffused among organisations within a field (DiMaggio & Powell, 1983; Scott, 1987). Therefore, if the institutional practice and norms to undertake sustainable farm dam management are widely supported throughout a region or industry, then it will be likely that their taken-for-granted assumptions are acquiesced to and not resisted. If these practices are only moderately voluntarily diffused, then it will be more likely for farmers to compromise in the face of sustainable farm dam management pressure (Oliver, 1991). At the same time, if farmers in a field do not have widespread sustainable farm dam management practice, norms and behaviours, then it will be more likely that the pressures to undertake poor dam

management activities (Pisaniello *et al.*, 2011b) will be actively defied or manipulated rather than conformed to (Tolbert & Zucker, 1983; Oliver, 1991).

Therefore, it is hypothesised that:

> Hypothesis 2b: Perceptions of voluntary diffusion of sustainable farm dam management norms and practices will be negatively related to resistance to sustainable farm dam management pressures.

4.6 Independent Variable 3 (IV3): Content

The content of institutional pressure to manage farm dams sustainably will be a critical predictor of strategic response. If the requirements of society are parallel to those of the organisation, then both parties can mutually agree on the rational course of action (Clemens & Douglas, 2005). However resistance to pressure will not only be dependent on the farm dam management *decision making discretion* that remains for farmers in light of the pressures imposed but also on the *inconsistency* of the content of the pressures with organisational goals. These two elements of independent variable 3 'content' modelled by Oliver (1991) will be discussed as follows.

4.6.1 Lack of decision making power (IV3a)

The demands of external institutional actors are received with less resistance if they do not negatively impact on the decision making discretion of organisational freedom (Pfeffer & Salancik, 1978). A lack of or limits on farmer *decision making power* imposed by institutional pressures for a particular management response has an important effect on perceptions of loss of autonomy and control (Thompson, 1967; Cook, 1977; Pfeffer & Salancik, 1978; Oliver, 1991). Farmers would be expected to acquiesce to pressure if they retain decision making power on activities such as the allocation of their water and sustainable practices. Avoidance would be the common response to pressure for practice that is removed from farmer control in order to decouple (Meyer *et al.,* 1983) activities from the pressure. Furthermore, threats to autonomy and control could incite a defiant or manipulative response in the face of pressure from the institutional environment (Oliver, 1991). It is suggested that resistance will be an increasing response for organisations when substantive organisational decisions, such as the amount of surface water runoff that can be stored for farming operations, are curtailed by regulatory pressure (Thomson, 1967).

Therefore, it is hypothesised that:

Hypothesis 3a: Perceptions of a lack of farmer dam management decision making power will be positively related to resistance to sustainable farm dam management pressures.

4.6.2 Inconsistency with organisational goals (IV3b)

Institutional pressure is more likely to be complied with if it is *consistent with organisational goals* (Oliver, 1991; Ingram & Simons, 1995). In addition, any conflict with the internal logic of water storage for a farmer could result in attempts by the farmer to buffer themselves from the pressure through avoidance or superficial changes to management practice (see Pisaniello *et al.*, 2012) to compromise with external constituents (Oliver, 1991). The provision of incentives or benefits that clearly align pressures with organisational goals will help organisations overcome perceived losses in efficiency resulting from reduced resistance to pressures (Pfeffer & Salancik, 1978; DiMaggio & Powell, 1983; Bansal & Roth, 2000). When standards placed on farmers are not consistent with their internal operations then the farmer may perceive they are in a position to lose profits or even the farming business which was a view supported by Powell and Freidkin (1986) in an investigation of public television stations. Covaleski and Dirsmith (1988) also highlight a resistant strategy of a university to budgetary management pressure because the budgetary process was perceived as inconsistent with the goals and efficiency gains of the university. What arises out of this perceived incongruence is organisations actively defying or manipulating pressure to conform (Oliver, 1991).

Therefore, it is hypothesised that:

Hypothesis 3b: Perceptions of inconsistency of farm dam management pressure with farmer goals will be positively related to resistance to sustainable farm dam management pressures.

4.7 Independent Variable 4 (IV4): Constituents

Institutional constituents often force institutional pressures on organisations that may or may not be constraining, coercive, voluntarily diffused, consistent, or in line with organisational goals. The state, industry groups, insurers and lenders, and the community can all force expectations on farmers. The collective pressures of these constituents are not always uniform and thus conflicting pressure can arise (Pfeffer & Salancik, 1978; Zucker, 1987; Oliver, 1991). An organisational field is formed around 'issues that bring together various field constituents with disparate purposes' (Hoffman, 2000a, p.352).

Organisational fields can be vast and varied but usually have the common elements of regulators, industry bodies, community, financial providers and other interest groups (Jennings & Zandbergen, 1995; Marshall *et al.,* 2005). The organisational field surrounding sustainable farm dam management includes (i) national and local regulatory bodies and representative field officers (Pisaniello *et al.*, 2011; 2012) (pressure captured by IV2 Control and the component of Legal Coercion), (ii) farming industry groups and professional bodies, (iii) sources of funding and insurance coverage, (iv) community groups, (v) environmental interest groups, and (vi) the media. When institutional and resource dependence perspectives are combined, there are two main effects of individual constituents in the field on firm strategy: *multiplicity* and *dependence* (Oliver, 1991). Sections 4.7.1 and 4.7.2 provide modelling of multiplicity and dependence on constituents as part of Oliver's (1991) organisational framework however additional sub-hypotheses (Sections 4.7.3 to 4.7.7) will test the specific bodies involved in placing pressure on farmers as it is considered critical to understanding of sustainable farm dam management response to constituents in that space.

4.7.1 Multiplicity (IV4a)

Multiplicity can be defined as the amount of conflicting expectations on an organisation (Pfeffer & Salancik, 1978; Oliver, 1991). Multiple constituents with conflicting institutional pressures and demands can create fragmentation within an institutional environment and reduce consensus among institutional actors (D'Aunno *et al.*, 1991; Oliver, 1991). The literature suggests that a low amount of multiplicity indicates that only one body requires answers which reduces confusion and pressure and is more likely to result in compliance with institutional pressures (Whetten, 1978). From a resource dependence perspective, an organisation is likely to desire reduced uncertainty and instability, which would be inherently created by multiple conflicting demands (Oliver, 1991). If regulators, interest groups and financial bodies are all placing pressure on a firm, the organisation may decide that the increase in legitimacy to be gained through compliance with them all is outweighed by the political uncertainties that come with this multiplicitous pressure (Cashore & Vertinsky, 2000). Different constituents can exert conflicting definitions of sustainable farm dam management on farmers which can cause them to perceive that incompatible and competing demands for safe or equitable dam management (Pisaniello *et al.*, 2012) to which they are very unlikely to acquiesce to but more likely to avoid, compromise and manipulate (Oliver, 1991). In addition, a farmer will be more likely to try and meet one constituent's demands, rather than me*et all* demands, such as the case with unintegrated

water equity and dam safety legislation with multiple regulatory bodies are demanding sustainable management (see Chapter 3, Section 3.4.3).

Therefore, it is hypothesised that:

> Hypothesis 4a: Perceptions of multiplicity of constituents will be positively related to resistance to sustainable farm dam management pressures.

4.7.2 Dependence (IV4b)

A firm's *dependence* on the organisations that exert pressure will predict their response to that pressure (DiMaggio & Powell, 1983; Oliver, 1991; Okhmatovskiy & David, 2012). As organisations in a field grow they become linked and increase the chance of achieving specified management practices. Institutional theorists argue that becoming more similar in a specified management practice, or 'isomorphism', is only likely if organisations are externally dependent (DiMaggio & Powell, 1983). Resistance to institutional pressure is more likely to occur when an organisation has low dependence on constituents and when external parties have less control over the allocation of critical organisational resources (Pfeffer & Salancik, 1978; DiMaggio & Powell, 1983). If a farmer is dependent on an organisation, such as a farming industry body for agricultural supply chain legitimacy, or a natural resources management board for access to increases in allocations and entitlements for runoff, then they are less likely to resist demands to manage sustainably.

Therefore, it is hypothesised that:

Hypothesis 4b: Perceptions of dependence on pressuring constituents will be negatively related to resistance to sustainable farm dam management pressures.

4.7.3 Industry bodies (IV4 Sub1)

Institutional theory indicates that organisations will be influenced by a professional or business association (DiMaggio & Powell, 1983, Weaver *et al*, 1999). In addition, institutional actors identified by Hoffman (2001b) whom are most likely to influence environmental practices directly at the plant level are industry associations. Oliver (1991) highlights that many professional associations attempt to become politically involved in standard setting and policy development in order to reduce loss of discretion on behalf of organisations who are perceived to be suitably experienced and to manage to a standard voluntarily. The existence of standards that are not developed in accordance with industry bodies can result in decoupling from the actual practice (Meyer *et al.*, 1983) which is bad for an entire industry if the practice is detrimental. Gupta and Lad (1983) report that accountancy industry bodies stepped in to establish corporate financial standards in order

to placate the takeover effects of the Securities and Exchange Commission (SEC). The result was the development of useful standards and the accounting industry benefiting from the regulator not dominating the entire process. Campbell (2007) also proposes that corporations will be more likely to be acquiescent to pressure to manage in social responsible ways if they belong to a trade association that promotes the responsible behaviour. If general or industry based farming industry bodies promote sustainable farm dam management then membership in these groups will be positively related to reduced resistance to pressure to manage farm dams sustainably.

Therefore, it is hypothesised that:

> Hypothesis 4 Sub1: Perceptions of farming industry body involvement in sustainable farm dam management will be negatively related to resistance to sustainable farm dam management pressures.

4.7.4 Insurers and banks (IV4 Sub2 and Sub3)

As many social and environmental issues become harder for governments to regulate they will rely on institutional investors to monitor and challenge bad behaviour to ensure organisations act in socially and environmentally responsible ways (Campbell, 2007). Financial intermediaries are playing an increasingly important role in sustainable management practice and have become more important for ensuring organisations act in a sustainable fashion. Furthermore, organisations are under increasing pressure from banks and insurers to report their sustainable management strategies (Elkington, 1994). Banks and lenders are beginning to evaluate the sustainability management practices of organisations requesting finance and regard poor social and environmental performance as high risk lending (Hoffman, 2000b). For example, the European Bank for Reconstruction and Development has written into its loan agreement that borrowing organisations must underpin activities with sustainability concepts and take responsibility for minimizing their environmental impact (Hoffman, 2000b). Insurers are also increasingly averse to social and environmental risk factors and many will factor this in to their underwriting practice. For example, Swiss Re has been increasingly vocal about its concerns over climate change and insuring organisations who are exposed to extreme weather patterns that pose a threat to individuals, communities and economies (Hoffman, 2000b). Farmers may be denied insurance policies or bank loans if they do not acquiesce to sustainable farm dam management pressures and thus financial body pressure is likely to result in reduced farmer resistance.

Therefore, it is hypothesised that:

> Hypothesis 4 Sub2: Perceptions of insurer involvement in sustainable farm dam management will be negatively related to resistance to sustainable farm dam management pressures, and
>
> Hypothesis 4 Sub3: Perceptions of banking involvement in sustainable farm dam management will be negatively related to resistance to sustainable farm dam management pressures.

4.7.5 Community groups (IV4 Sub4)

Corporations will be more likely to act in socially responsible ways if independent parties monitor and move to change bad behaviour (Schneiberg & Soule, 2005; Campbell, 2007). Local communities can exert pressure on organisations through their vote in elections, through activism or filing lawsuits (Delmas & Toffel, 2004). Henriques and Sadorsky (1996) in their study of 700 firms found that community group pressure influenced firms to adopt an environmental management plan. In addition, Raines (2002) reports from a quantitative and qualitative analysis of ISO14001 certified companies, that motivation to achieve certification was significantly driven by desire to be a 'good neighbour'. Furthermore, when community groups are aligned with, or part of non-government organisations (NGOs), they can create significant pressure on an organisation to act in more socially and environmentally responsible ways and their pressure can be such that organisations do not wish to be noticed for bad behaviour and will acquiesce to pressure (Campbell, 2007).

Therefore, it is hypothesised that:

> Hypothesis 4 Sub4: Perceptions of community group involvement in sustainable farm dam management will be negatively related to resistance to sustainable farm dam management pressures.

4.7.6 Environmental groups (IV4 Sub5)

In communities where citizens are actively involved with environmental interest groups there is more likely to be more lobbying for strident environmental regulation and pressure from the environment on firms (Maxwell *et al.,* 2000). Organisations are coming under increasing pressure from environment groups who are demanding more information about organisations' environmental goals and performance (Elkington, 1994). Hamilton (1999) finds decreases in toxic emissions in plants in states with higher memberships in environmental interest groups. Boycotts caused by negative environmental group attention,

can be extremely damaging to an organisation. Greenpeace's boycott of Shell Oil for moves to sink an offshore oil platform, the 'Brent Spar', caused major unrest in the industry in Europe and beyond and resulted in Shell acquiescing to the pressure and shelving the environmentally controversial plan (Brooks, 2002). Similarly, boycotts against Nike for sweatshop manufacturing practices resulted in its stock price and revenues dropping and ultimately the organisation making substantial improvements in their sustainability strategies (Brooks, 2002). Furthermore, when environmental groups apply pressure directly, organisations are likely to compromise or acquiesce to the pressure (Cashore & Vertinsky, 2000).

Therefore, it is hypothesised that:

> Hypothesis 4 Sub5: Perceptions of environmental group involvement in sustainable farm dam management will be negatively related to resistance to sustainable farm dam management pressures.

4.7.7 Media (IV4 Sub6)

The media play an important role in bringing attention to issues of sustainable development and also the mobilisation of further attention from social and environmental groups (Bansal, 2005). The media does have a role in shaping institutional norms generally; insofar that it highlights what are important issues for society to pay attention to, often based largely on its own editorial values (Bansal, 2005). Importantly, the media has a particularly influential role in shaping organisational responses, not only through raising firm visibility and providing opportunity for public criticism, but also by reduced legitimacy (Bansal & Roth, 2000; Bansal & Clelland, 2004). Lawrence and Morell (1995) find that improvements to sustainability management came about because of the organisation's concern over the attention and publicity about their lapses in environmental responsibility. The media have the power to monitor and report unsustainable organisational behaviour resulting in a constant underlying threat of public exposure (Campbell, 2007). Hence, the media are playing an ever increasing role in corporate governance and reduced resistance to socially and environmentally responsible and sustainable management.

Therefore, it is hypothesised that:

> Hypothesis 4 Sub6: Perceptions of media involvement in sustainable farm dam management will be negatively related to resistance to sustainable farm dam management pressures.

4.8 Independent Variable 5 (IV5): Cause

The cause of institutional pressures relates to the underlying motives for introduction of the rules in the first place (Zucker, 1987; Goodstein, 1994). When institutional demands can create legitimacy gains, resistance to them will be difficult (Dowling & Pfeffer, 1975; Meyer & Rowan, 1977). Institutional theory has been criticised for not considering the factors that lead to institutional pressures (Zucker, 1987; Scott, 2001) however Oliver's (1991) model incorporates the potential for pressures caused by a need for *social fitness* and a need for *economic fitness*. These two categories will be discussed as follows.

4.8.1 Social fitness (IV5a)

When a manager of a firm believes that compliance with rules or norms will enhance *social fitness*, then they will likely to be less resistant to pressure from the institutional environment (Oliver, 1991). Etherington and Richardson (1994) found that where institutional pressure was strong, organisations were more likely to focus on legitimacy in their social environment. For example, compliance with rules for farm dam management that improves perceptions of the farmer to communities downstream. An acquiescent response is common but on a continuum where more moderate resistance is possible if the perceived rewards are low (Oliver, 1991). As organisations become increasingly similar through the adoption of norms and behaviours, they gain increasing legitimacy throughout a field (Tolbert & Zucker, 1983; Fligstein, 1985) and as norms diffuse, organisations will try to adopt them to secure scarce resources or remain competitive – failure to do so could be a threat to social fitness and hence access to scarce resources (DiMaggio & Powell, 1991). A farmer would be likely to acquiesce to sustainable farm dam management pressure if the perception of improved social fitness, such as that coming from neighbours who may be observing the farmer's dam management (Pisaniello & McKay, 2007), was high but may also question the legitimacy gains that could result from an acquiescent response to sustainable farm dam management pressure and therefore attempt to compromise on the requirement and manipulate if necessary.

Therefore, it is hypothesised that:

> Hypothesis 5a: Perceptions of social fitness and legitimacy available from sustainable dam management activity will be negatively related to resistance to sustainable farm dam management pressures.

4.8.2 Economic fitness (IV5b)

Unhealthy financial conditions create opportunities for organisations to subvert social welfare, for example disregard safety, undertake environmental damage or deceive regulators, in order to pursue profit growth and maximisation (Vogel, 1992; Albert, 1993; Dore, 2000; Campbell, 2007). In fact, the imperative of *economic fitness* is so great that it can be a 'root cause that may prevent corporations from acting in socially responsible ways' (Campbell, 2007, p.952). When the perception of economic gain is low (such as the requirement to spend money to maintain a spillway (Pisaniello & McKay, 2007) despite the farmer perceiving that the dam poses no threat to lives or property) then the farmer will be more likely to resist imposed pressure to manage sustainably. However, if the dam poses threat to lives and property and there would be obvious economic detriment to the farmer if the dam failed, the farmer would be more likely to acquiesce to demands to maintain it and manage sustainably.

Therefore, it is hypothesised that:

> Hypothesis 5b: Perceptions of economic gain available from sustainable dam management activity will be negatively related to resistance to sustainable farm dam management pressures.

4.9 Moderating Variable (ModV): Institutional environment

In the social and behavioural sciences (see Baron & Kenny, 1986; Hall & Rosenthal, 1991), management (see Aguinis, 1995), and marketing (see Irwin & McClelland, 2001), there has been a level of theoretical sophistication reached that moves beyond detection of the main effects of the independent variables on the dependent variables, but also their moderating effects (Zedeck, 1971). The moderator function of a variable is to partition a focal independent variable into subgroups, such as settings or location, which establishes domains of maximum effectiveness in regard to a given dependent variable (Baron & Kenny, 1986). This is distinguished from the possible mediating effect of a variable which positions itself in the causal pathway between the independent and dependent variables and 'represents the generative mechanism' of effect (Baron & Kenny, 1986, p.1,173).

Previous management research has viewed environments as a constraint that affects the relationship or response to a strategy that a farmer can change (Hofer & Schendel, 1978; Pfeffer & Salancik, 1978; Prescott, 1986). It is common in the medical and education literature to conduct multi-site studies and in these cases, the moderating effect of the site

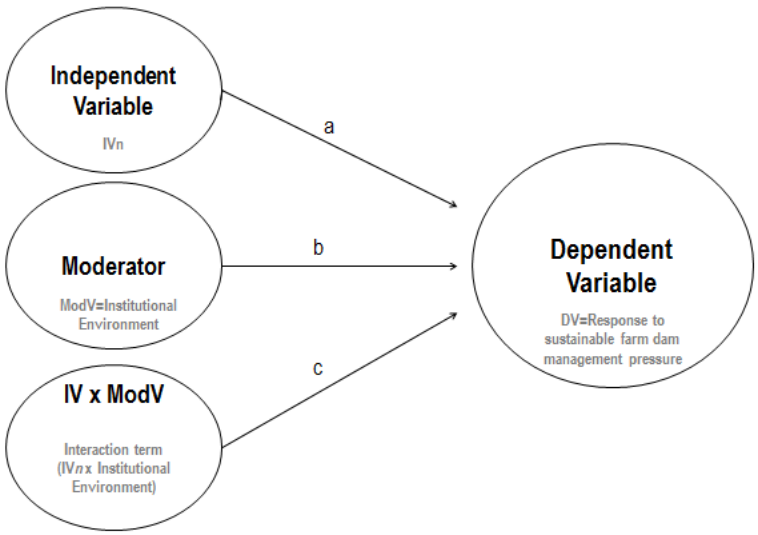
characteristics on a given relationship is measured (Raudenbush & Liu, 2000). Strategic management literature has considered that environments of farmers moderate relationships to strategy (Jauch *et al.*, 1980; Hitt *et al.*, 1982; Prescott, 1986).

In the context of this research which addresses sustainable farm dam management response to institutional pressure in Australia, the institutional environment of the farmer is proposed to have a significant moderating effect on response. Because of the critical differences in the safety and equity mechanisms in institutional environments between states and territories (see Chapter 3, Section 3.5), the location, or 'Institutional Environment' of the farmer will be a moderating factor in the relationship between each independent variable and the dependent variable.

The relationship between each institutional antecedent and the dependent variable will be different in varying locations with different levels of institutional pressures. Figure 4.2 narrows the moderating relationship presented in Figure 4.1 to highlight the specific relationship effect of the moderator and the predictive paths that feed into the outcome/dependent variable. IVn is independent variable number n, the moderator is sustainable farm dam management institutional environment, and the interaction term is the two multiplied together (once standardised, see Chapter 5, section 5.5.3.2 for further discussion). Moderation exists if Path c to the dependent variable is significant (Baron & Kenny, 1986).

Figure 4.2 - Moderator model

(Baron & Kenny, 1986, p.1,174)



The benefit of including multiple test sites in the model is that it allows for the possibility of uncovering site-by-site interaction effects which would otherwise be ignored (Raudenbush & Liu, 2000). Prior literature concludes that empirical research using environments as moderators can influence the relationships of independent variables to strategy, varying the strength, and potentially the direction, of these relationships (Prescott, 1986). On that basis, and without any firm literature or theoretical foundation on which to base directional hypotheses, the research broadly proposes that: *Institutional environments will moderate the relationships between independent institutional antecedents and strength of strategic response.*

This overarching proposition overlays the above hypotheses, adding a layer of interaction analysis. The layer is broad enough not to limit the investigation of determination of overall moderation effects, but facilitates insight into moderated strength and directional relationship changes between independent variable subgroups separately.

4.10 Summary

Chapter 4 has provided a theoretical and conceptual framework for testing and analysis based on the literature in Chapter 2 and institutional environment review in Chapter 3. The chapter has contributed towards understanding of the institutional pressures that can cause a sustainable farm dam management response from farmers (Research Problem 2). By maintaining focus on the critical area of investigation of sustainable farm dam management whilst using a novel theoretical model, the chapter develops 16 testable research hypotheses based on Oliver's (1991) instrumental modelling of strategic response typologies. All of the 16 hypothesised relationships are predicted to be moderated by an additional variable of location, or sustainable farm dam management institutional environment, which at different levels is proposed to affect the strength and potentially the direction of relationships of the institutional predictors to the strategic response dependent variable. The 16 hypotheses will be tested in Chapter 6 after presentation of the research design and methods in Chapter 5.

Chapter 5

Research design and methods

5.1 Introduction

Chapters of this thesis have established the context and theoretical issues surrounding management for sustainability of farm dams. This contextual and theoretical underpinning contributes toward addressing the main research problem of lack of understanding of the relationship between sustainable farm dam management pressures from the institutional environment and farmers' resistance to these pressures. Chapter 1 provided the introduction leading to Chapter 2 which facilitated presentation of the problem of sustainable farm dam management in the context of Oliver's (1991) theoretical framework and related theoretical foundations employed to address the problem.

Previous research has paid little attention to the critical importance of a farmer's water storage management strategies when faced with pressures from their environment and so Chapter 3 sought answers to part 1 of the main research problem, or Research Problem 1, by providing an understanding of the equity and safety institutional environment of farm dam managers. Chapter 4 addressed Research Problem 2, by identification of the pressures that can cause a sustainable farm dam management response from farmers and developing testable hypotheses. Before Research Problem 3 can be addressed to improve understanding of the relationship between farmers' perceptions of sustainable farm dam management in relation to the institutional environment and the potential for resistance, this chapter is required to describe the study design and methods used towards this pursuit. This chapter contributes an overview of the research objectives and approach, the selection of the sample, development of measurement scales, survey administration, response rates and issues associated with reliability and validity, in addition to detail of the statistical tests to be employed.

5.2 Objectives and approach

As identified in Chapter 1, the overarching objective of the research is to examine resistance of farmers to institutional pressures exerted to manage dams sustainably. However, a number of practical objectives also need to be achieved in this chapter. Firstly, it is necessary to choose test states for analysis of farmer perceptions from various sustainable farm dam management institutional environments. Chapter three's review of

key institutional pressures in the area of sustainable on-farm surface water storage in each state in Australia allowed for overview of all states and territories which will facilitate the basis of the choice. Secondly, the best way to garner the perceptions of those that manage the on-farm surface water storage in the institutional environments selected needs to be outlined.

A quantitative survey approach is appropriate for research problems that require human issues investigated, self-reported beliefs, behaviours and perceptions for hypothesis testing (Neuman, 2006). The approach to the research is a quantitative telephone survey design. Survey research of farmers allows for capture of data uniqueness, an unbiased representation of the population of interest, and standardisation of measurement. However, survey research is not without its theoretical weaknesses and limitations which are well-examined in the literature (see Pinsonneault & Kraemer, 1993), especially in the strategic response and management literature (Hill & Hansen, 1991; Lubatkin & Chatterjee, 1991; Bergh, 1995; Bowen & Wiersema, 1999). Survey method and design is often critiqued for weaknesses that include the need for additional methods to complement surveys and overreliance on cross-sectional surveys where a longitudinal approach is really needed (Pinsonneault & Kraemer, 1993). Cross-sectional methods such as surveys can fail to adequately address the possibility that the relationships investigated might vary systematically over time (Bowen & Wiersema, 1999). This is noted by the researcher however farmer beliefs, behaviours and perceptions are the focus of this study, rather than time related behaviours and this is supported by much of the strategic management literature where cross-sectional survey methods remain a very common form of analysis, even if at odds with acknowledgement that manager/farmer parameters are not constant over time (Bowen & Wiersema, 1999). In addition, this study operates within a pragmatic paradigm that focuses on serving human purposes by addressing a human issue in critical need of attention in a timely way, but at the same time is also deeply rooted in the need for research to have practical value (Wicks & Freeman, 1998). A positivistic epistemology is most common for survey research (Neuman, 2006). However, the pragmatic orientation adopted here allows the researcher to undertake research with practical value but encourages timeliness and innovative approaches to problems (Astley, 1985).

5.3 Research design

Clear research design is critical in the process of research planning and should be formulated commencing with the parameters of a well-defined statistical population and sample, or statistical inference will be limited. The following sections detail the design

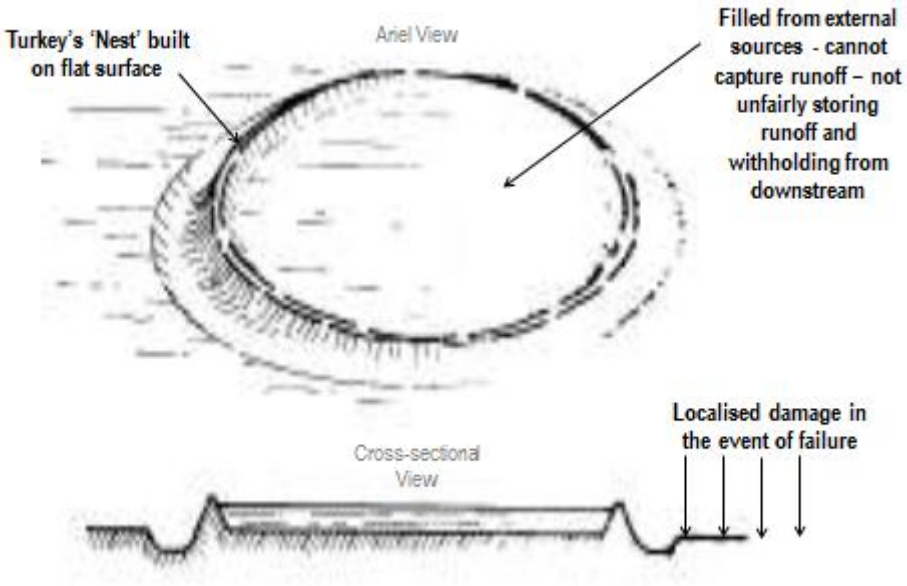
commencing with discussion of the population of interest and the test states, the sampling unit, development of the sampling frame, and the resulting sample, finishing with ethical considerations of the design.

5.3.1 Study population

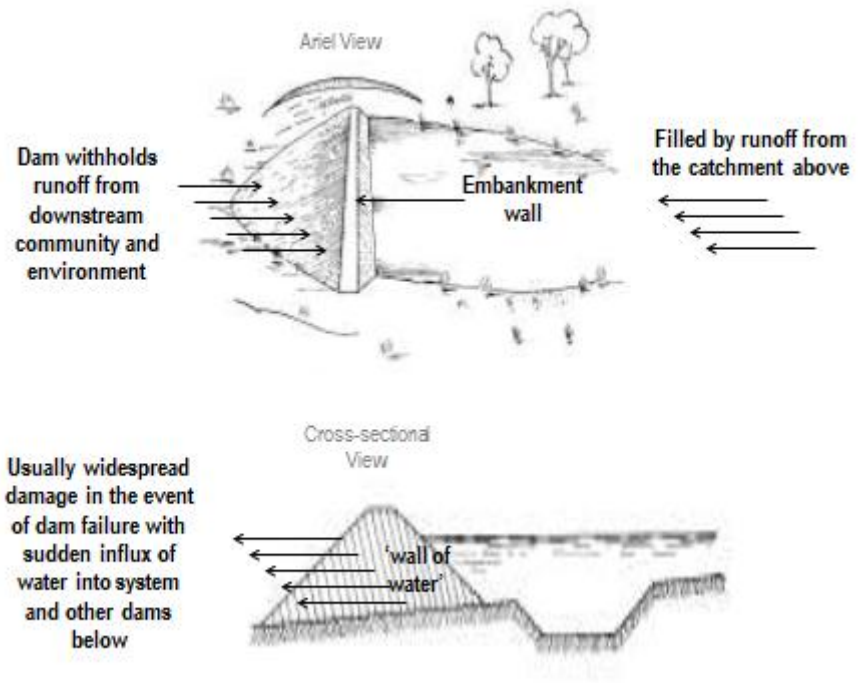
The research population has an important role in the choice of sampling strategy. The temporal, spatial and geographic boundaries are put in place by the researcher and defined precisely. The population of focus for the research is owners or managers of catchment farm dams which are water storage structures constructed in rural areas for capturing surface water runoff generated from the catchment area above them. Targeting owners and managers of catchment dams allows the researcher to focus on the effect of individual or multiple dams where there is the potential for a cumulative impact from inequitable water sharing, or threat from unsafe water storage, within the test states. Dams managed in catchments carry more risk to the community and environment through unfair sharing (Liddicoat *et al*., 2010) and unsafe storage of water (Pisaniello, 1997) than dams managed on flat ground. Hence, dams located on flat ground, such as Turkey's Nest dams, were not considered by this research (Figure 5.1(a) and (b)).

Figure 5.1 – Comparison of Catchment Dam and Turkey's Nest Dam*

(a) Turkey's Nest Dam



(b) Catchment Dam

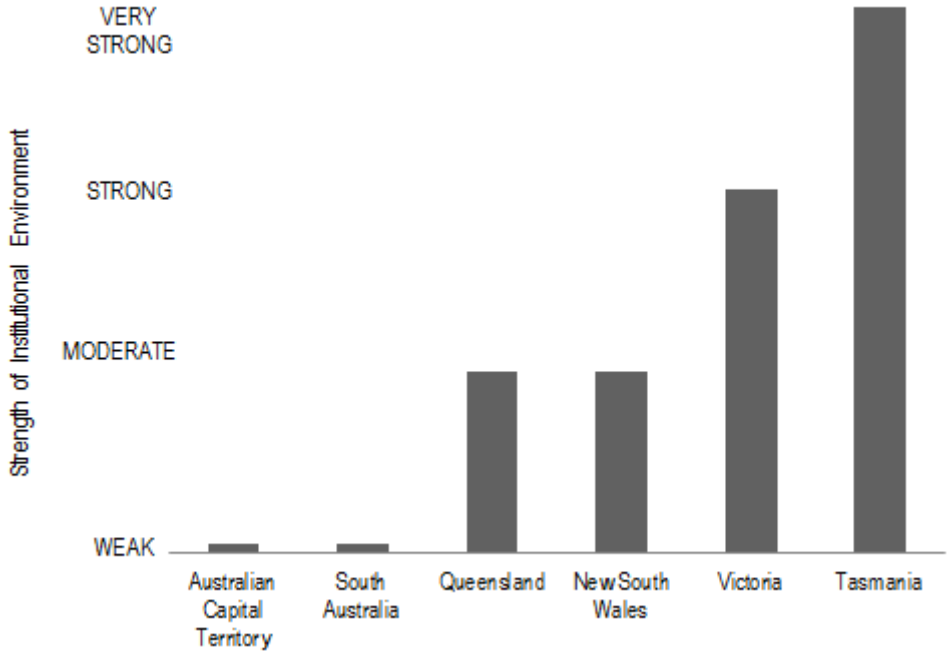


*Base drawings courtesy Nelson (1985)

5.3.1.1 Test states

Before gathering the farmer survey samples, a budget and time constrained choice was made to target four specific states from the six states and two territories included in the final review of the Australian sustainable farm dam management institutional environment in Chapter 3. There are varying levels of on-farm surface water sharing and safety institutional mechanisms around Australia and so states representing the full range were chosen from which to recruit farmer participants. Figure 5.2 demonstrates the results of the investigation in Chapter 3, highlighting that four of the test states were in fact able to represent the maximum variance in strength of institutional environment, in areas where sustainable farm dam management is likely to have an impact. Figure 5.2 is based on the analysis of four components of content and integration, accountability monitoring, accountability for small dams, and equity and safety reporting, facilitated identification of jurisdictions that represent the spectrum of weak farm dam institutional environments to very strong farm dam institutional environments. The assumptions associated with the measure are such that however, the researcher has overcome this limitation through reliance on the strong body of literature surrounding the area in addition to the objective reference to policy instruments in place in each environment.

Figure 5.2 – Summary of the equity and safety institutional environment in Australia derived from Chapter 3

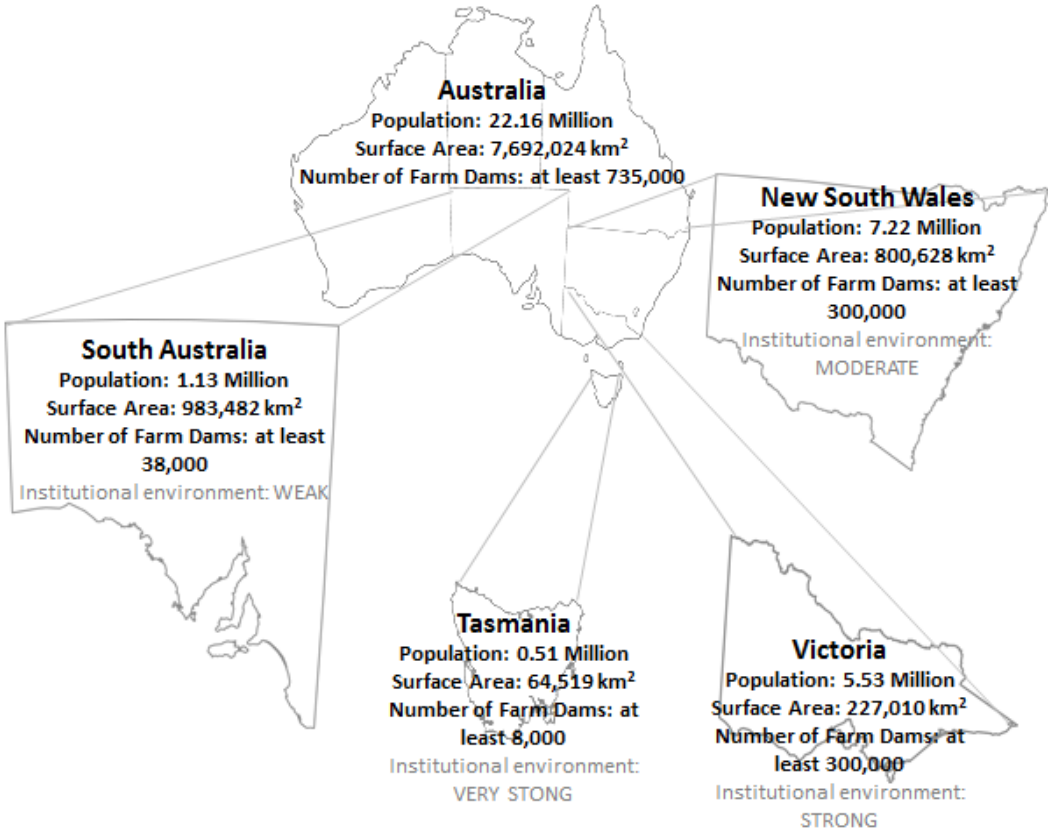


From the two states providing a measure of 'weak' institutional environment, it was decided to remove the Australian Capital Territory because it did not provide any additional information above the inclusion of South Australia, but has less dams and thus a smaller population to draw from (approximately 1000 farm dams in the ACT compared to at least 38,000 in South Australia). From the two states representing 'moderate' strength of institutional environment in Figure 5.2 (Queensland and New South Wales), it was decided to remove Queensland because, like Victoria it has integrated equity and safety institutional mechanisms therefore offers little additional contribution. New South Wales provides the unique perspective of a strong, separated equity and safety mechanism state and also has estimates of 300,000 farm dams, where Queensland only has 6,400.

Therefore, the test states of Tasmania (very strong institutional environment) and South Australia (weak institutional environment) were chosen to represent either end of the trend changes in strength. In between these two ends, New South Wales was chosen, with a moderate strength institutional environment, in addition to Victoria, with a strong institutional environment. These two states were chosen because they represent contrasting, divergent approaches to integration of equity and safety mechanisms. Therefore, the four states represent the maximum variation in policy strength and integration of equity and safety laws.

Figure 5.3 provides visual representation of the location of the four test states in Australia and their demographics in relation to the strength of the sustainable farm dam management institutional environment determined by the review in Chapter 3.

Figure 5.3 - Four Australian test states with contrasting dam management institutional environments*



*Source of demographic data: McMurray (2004, 2007), DPIWE (2005), Baillie (2008), Ditchfield (2008 pers.comm. 25 June), ABS (2009), AGGA (2009)

5.3.2 Sampling unit - Farmers as participants

To understand sustainable farm dam management, research must thoroughly explore the context in which farmers make decisions about their farm dams. This includes their perceptions of farm dam management practice and their attitudes toward real and perceived institutional pressures to manage dams in a certain way. Farmer perceptions are the unit of analysis rather than a broader view of the organisation as their views represent those of the organisation and very frequently, the organisation is very small in terms of numbers of other employees (Australia.gov.au, 2011; NFF, 2012). Adequate information about farmers' sustainable farm dam management perceptions can be obtained through farmer surveys. Unfortunately, it is reported that a large percentage of farmers do not respond to mail surveys (Pennings *et al.*, 2002) which is often related to the perceived

length of the questionnaire. This was taken into consideration by the researcher when developing the questionnaire and also informed the choice of survey method.

5.3.3 Sampling Frame

The target population in each test state is not known with great accuracy, but using the best estimates from the current literature, the sampling ratios are defined in Table 5.1. The sampling frame from which the sample was randomly drawn was developed from publicly available information in a telephone directory combined with online map services (for example, Google Earth). Telephone contact lists were developed from the White Pages online service by the researcher using sampling of regions known to be of undulating topography where farm dams were common. Identified prospective participants from sampling of high catchment dam concentration regions were then cross-checked with Google Earth to verify the existence of a farm dam in a cumulative scenario.

Table 5.1 - Sampling ratio in the context of data surrounding four test states

	South Australia	New South Wales	Victoria	Tasmania
Approximate Physical Farm Dam Population	38,000	300,000	300,000	8,000
Farmer Sampling Frame	790	942	1169	578
Sampling Ratio	2.08%	0.31%	0.39%	7.23%

Neuman (2006) specifies that the larger the populations the smaller the sampling ratio required. Neuman (2006) suggests that for populations over 150,000, a smaller sampling ratio of around 1% is usually sufficient for sampling accuracy. The sampling ratios in this study are all around or above 1%, and increase for smaller populations and therefore considered suitable for the study.

5.3.4 Sample

Stratified probability sampling allows for division of the population into subpopulations or strata on the basis of differentiating information and then drawing randomly from those strata (Neuman, 2006). This method will produce samples that are more representative of the population of catchment dam owner/managers than simple random sampling especially when there is significant differentiating information such as the type of dams considered by this research. Therefore categorising that divides a population, in this case, farmers in areas and industries likely to have catchment dams, allows for random sampling from that category. Farmers were sampled initially by region, then by industry or type of farming.

5.3.5 Ethical considerations

The farmer survey data collection method was granted ethical approval in 2011 by the University of South Australia Human Research Ethics Committee (Protocol Number 24946). This data collection provided autonomy for the participants (NHMRC, 2007). Because participation was voluntary and the farmers could refuse to participate at any time, the recruitment of participants was considered fair and equitable (NHMRC, 2007). The participants gave 'informed consent' and the questions did not reveal any personal information or impact negatively on them (Neuman, 2006; Babbie, 2010). The farmer participants were expected to experience positive benefits as a collective from the perceptions they provide in the survey as to what pressures help them manage their farm dams in a sustainable way for their farming operations and the future of agriculture in the region. These perceptions could then enable the development of guidelines for the optimal sustainable farm dam management institutional environments that could influence policy.

5.4 Research methods

Survey research enables the capturing of people's behaviours, attitudes, beliefs, opinions and expectations (Neuman, 2006). Survey research facilitates the careful implementation of logical understanding through rigorous development and testing of theoretical and conceptual explanations allowing for testing of complex research propositions (Babbie, 1973). A quantitative survey is highly suitable for this study because of the rigorous theoretical framework applied to a complex, real world problem of farmer resistance to sustainable on-farm water storage management pressure. Furthermore, the survey method permits a clear elaboration of a logical model which allows for relationships between variables to be identified, which is crucial to the theoretical and conceptual model developed, as presented in Chapter 4. Finally, survey research allows for generalisability to the broader population from which the sample was selected and this understanding of the larger population of on-farm water storage managers within catchments can be facilitated.

For a survey research instrument to be valid, it must have the same meaning to the survey participant as to the researcher (Salkind, 2000). This means that it needs to be formulated in a culturally and demographically meaningful and appropriate manner (Neuman & Wiegand, 2000). Survey questions are not legitimate when they are based on concepts or assumptions alien to the demographic of potential respondents, such as asking a farmer about his or her cumulative impact/threat downstream when this language may not be a part of the common system of meaning for the farmer. It is thus important to find

appropriate expressions in the local context and failure to do so can result in erroneous data since they are based on answers rooted in a misunderstanding (Schuessler, 1985). The survey research instrument was developed in accordance with the surrounding literature and also pretested on two researchers with over 20 years' experience working with farmers and their water storage practices (see Section 5.4.4.1). The following sections describe the design of the instrument used for this research.

5.4.1 Instrument development

The review of the farm dam management literature and the seminal combination of institutional and resource dependence theories by Oliver (1991), in addition to analysis of the application of Oliver's framework to other study areas (see Chapter 2, section 2.4.3), allowed for maximised use of pre-tested or logically derived items applied to the novel area of on-farm water storage. A total of 97 short closed ended questions were developed (see Appendix 1 for full instrument[4]).

5.4.2 Reliability and validity

Reliability and validity are critical issues of measurement which relate to connecting survey measures with constructs and although impossible to achieve perfectly, their attainment nevertheless should be strived for (Neuman, 2006). Each will be discussed in turn in the following sections.

5.4.2.1 Reliability

Table 5.2 demonstrates each variable measure showing efforts to increase reliability by clear conceptualisation through foundations in literature, and use of established measures applied to farm dam management. Each measure is associated with its supporting literature that contributed to the careful and deliberate conceptualisation (see Appendix 2 for survey item justifications, and Appendix 3 for means, standard deviations and variance for each item). Reliability can be tested statistically using Cronbach's alpha which tests how well the elements of a measure correlate with each other, that is, are internally consistent. Chapter 6 presents the full results of statistical reliability testing.

There are three main types of reliability identified in the literature: stability, representative, and equivalence reliability (Neuman, 2006). The first, stability reliability, refers to reliability across time and can be verified through pretesting and the original group in the pre-test having the same results as the later sample (Neuman, 2006). This research employs pretesting which is discussed further in Section 5.4.4. The second type of reliability is

[4] The questionnaire in Appendix 1 is not the final version of the instrument that was administered in the field.

representative reliability, which refers to reliability across subpopulations of people and can be tested by checking an indicator across different groups, such as states (Neuman, 2006). This study does enable cross state comparison and is not limited to one single state, thereby improving representativeness reliability. The third and final type of reliability, equivalence reliability, applies when a construct is measured with multiple specific measures and can be tested statistically using the Cronbach's alpha coefficient (see Section 5.5.2). Overall, reliability is improved by this study by clear conceptualisation on constructs founded in the literature (Table 5.2), and also increasing the level of measurement, here the use of a 7-point Likert scale, as opposed to 3- or 5-point (see also Section 5.4.3).

Table 5.2 - Variable measures

Hyp	Variable	Construct	Measure (Likert 1-7 scale)	Literature
1 - very strongly disagree 2 - strongly disagree 3 - disagree 4 - neutral 5 - agree 6 - strongly agree 7 - very strongly agree				
All	DV1	Acquiescence	ACQU1: I manage my dam in the same way we always have on this farm	Meyer & Rowan, 1977; Pfeffer & Salancik, 1978; Scott, 1987; Orton & Weick, 1990; D'Aunno, 1991; Oliver 1991; Etherington & Richardson, 1994; Ingram & Simons, 1995; Scott, 2001; Goodstein, 1994; Bansal, 2005; Clemens and Douglas, 2005; Pisaniello & McKay, 2007; Pisaniello *et al.*, 2011b; Pisaniello *et al.*, 2012
			ACQU2: I speak with others who work on the farm and adopt the best farm dam management approach used in the past	
			ACQU3: I speak with others who work on the farm about the best farm dam management approach they currently recommend and adopt that approach	
			ACQU4: I follow the dam management approach that is used by other successful farmers in the area	
			ACQU5: I make a conscious evaluation of specific dam laws and choose to comply with them	
			ACQU6: I communicate with the regulators to determine the best way to comply with the spirit and intent of the dam management laws	
	DV2	Compromise	COMP1: I negotiate openly with the regulators to obtain a mutually agreeable solution on management of my dam	
			COMP2: I obtain consensus with the regulators about my farm dam management for the benefit of communities downstream	
			COMP3: I negotiate with the regulators to obtain an advantageous dam management situation for the community downstream	
			COMP4: I bargain with the regulators to obtain a favourable dam management situation for the community downstream	
			COMP5: I partially conform with the specific dam management laws that are most important to the regulators	
			COMP6: I determine the most important elements of dam management for regulators and agree to comply	
	DV3	Avoidance	AVOID1: I appear to comply with dam management laws but intentionally avoid certain aspects of the requirements	
			AVOID2: I conceal certain aspects of my farm dam management from the regulators	
			AVOID3: I purposefully block my spillway to build up my water supply	
			AVOID4: I avoid in dealing with any industry bodies that are worried about dam management	
			AVOID5: I would consider moving spillway blockages to avoid detection by regulators	
			AVOID6: I would consider growing intense vegetation near the dam to remove access to regulators	
	DV4	Defiance	DEFI1: I ignore the dam management regulations and just get on with my business	
			DEFI2: I ignore the dam management regulations and attempt to avoid any discussion with regulators	
			DEFI3: I would sue the regulator agency for overly burdensome dam management requirements	
			DEFI4: I would challenge dam management requirements in court	
			DEFI5: I would challenge dam management requirements through the media	
			DEFI6: I would mount a campaign with the farmers around me and the community to attack the regulatory authority about dam management laws	
	DV5	Manipulation	MANI1: I attempt to form an alliance with the regulators regarding my dam management	

			MANI2: I attempt to include a regulator in my dam management decision making		
			MANI3: I attempt to influence public perceptions on how well I manage my dam		
			MANI4: I organise the farmers around me and the community to attempt to influence the dam management regulatory requirements		
			MANI5: I meet with elected politicians to attempt to control the regulators on dam management issues		
			MANI6: I attempt to deal with federal regulators to control the state and local government on dam management issues		
H1a	IV1a	Context	Environmental uncertainty	CONTX-ENV1: I am worried about the future of water availability to continue my farming operations	Meyer & Rowan, 1977; Zucker, 1977; Pfeffer & Salancik 1978; DiMaggio & Powell, 1983; Meyer *et al.*, 1983; Scott, 1987; DiMaggio, 1988; Oliver, 1991; Goodstein, 1994; Pisaniello *et al.*, 2012
				CONTX-ENV2: I block my spillway because of the uncertainty of future runoff in my region	
H1b	IV1b		Inter-connectedness	CONTX-INTER1: Most of the farmers in my region manage their dams in the same way	DiMaggio and Powell, 1983; Hamel *et al.*, 1989; Oliver, 1991; Jennings & Zandbergen, 1995; Henriques & Sadorsky, 1996; Florida & Davidson, 2001; Raines, 2002; Clemens & Douglas, 2005
				CONTX-INTER2: I have worked with other farmers on dam management issues	
				CONTX-INTER3: The farmers around me share the water fairly	
H2a	IV2a	Control	Legal Coercion	CONTR-LEG1: I have received a notice from the regulator to change my dam management practice	DiMaggio & Powell, 1983; Oliver, 1991; Wood, 1991; Jennings & Zandbergen, 1995; Weaver *et al.*, 1999; Bansal, 2005; Pisaniello *et al.*, 2011a
				CONTR-LEG2: I am fearful of enforcement of dam management laws by regulators	
				CONTR-LEG3: The regional field officer periodically checks my dams	
				CONTR-LEG4: I feel pressure from government about my dam management behaviour	
				CONTR-LEG5: I am dependent on government for dam management information and education	
				CONTR-LEG6: The authority periodically checks my water meter	
				CONTR-LEG7: The laws require me to provide too much water for the environment	
				CONTR-LEG8: The maximum storage capacity of my dam is checked periodically	
				CONTR-LEG9: Regulations require me to have an Emergency Action Plan for my dam as part of my dam management	
				CONTR-LEG10: Regulations require me to periodically report on the safety of my dam as part of my dam management	
H2b	IV2b		Voluntary diffusion	CONTR-VOL1: My neighbours and I manage our dams in a way that limits the impact of our farming operations, not because of any regulations	Tolbert & Zucker, 1983; Fligstein, 1985; Oliver, 1991; Pisaniello *et al.*, 2011a
				CONTR-VOL2: There is no need for so much regulation as farmers around me do the right thing anyway	
				CONTR-VOL3: I think the spillways of my dam are safe	
H3a	IV3a	Content	Lack of decision making power	CONT-DEC1: The dam management regulations restrict me from storing water for my usual farming operations	Thomson, 1967; Cook, 1977; Pfeffer & Salancik, 1978; Meyer *et al.*, 1983; Oliver, 1991
				CONT-DEC2: I am limited by the laws that tell me how I must store my water in my dam	
H3b	IV3b		Inconsistency with organisational goals	CONTE-CONS: The dam management regulations are not in line with the goals of this farm	Powell & Freidkin, 1986; Covaleski & Dirsmith, 1988; Ingram & Simon, 1995; Bansal & Roth, 2000; Pisaniello *et al.*, 2012
H4a	IV4a	Constituents	Multiplicity	CONST-MULT: There are too many organisations putting pressure on me about my farm dam	Pfeffer & Salancik, 1978; Whetten, 1978; D'Aunno, 1991; Oliver, 1991; Cashore & Vertinsky, 2000; Pisaniello *et al.*, 2012

H4b	IV4b		Dependence	CONST-DEP: I am dependent on government funding so that is why I comply with what the regulators want for my farm dam	Pfeffer & Salancik, 1978; DiMaggio & Powell, 1983; Oliver, 1991
H4 Sub1	IV4 Sub1		Industry groups	CONST-SUB1: My farming industry association guides me on the best way to manage my dam	DiMaggio & Powell, 1983; Gupta & Lad, 1983; Oliver, 1991; Weaver *et al.*, 1999; Hoffman, 2001a; Campbell, 2007
H4 Sub2	IV4 Sub2		Insurers	CONST-SUB2a: My insurance policy has a clause related to farm dams	Elkington, 1994; Jennings & Zandbergen, 1995; Hoffman, 2000a; 2000b; Campbell, 2007
H4 Sub3	IV4 Sub3		Banks	CONST-SUB2b: My bank requires info about my farm dam	
H4 Sub4	IV4 Sub4		Community groups	CONST-SUB3: I attend local community meetings that discuss farm dam issues	Jennings & Zandbergen, 1995;Henriques & Sadorsky, 1996; Raines, 2002; Delmas & Toffel, 2004; Schneiberg & Soule, 2005; Campbell, 2007
H4 Sub5	IV4 Sub5		Environmental groups	CONST-SUB4: I discuss with local environmental groups, the best way to manage my dam	Elkington, 1994;Hamilton, 1999; Cashore & Vertinsky, 2000; Maxwell *et al.,* 2000; Brooks, 2002
H4 Sub6	IV4 Sub6		Media	CONST-SUB5: I have changed my dam management practice because of an article in the media	Lawrence & Morell, 1995; Bansal & Roth, 2000; Bansal & Clelland, 2004; Bansal, 2005; Campbell, 2007
H5a	IV5a	Cause	Social fitness	CAUS-SOC1: I comply with dam management regulations so I do not upset the farmers downstream	Tolbert & Zucker, 1983; Etherington & Richardson, 1994; Fligstein, 1985; DiMaggio & Powell, 1991; Oliver, 1991; Pisaniello & McKay, 2007
				CAUS-SOC2: I have had complaints about my dam management from neighbours	
H5b	IV5b		Economic fitness	CAUS-ECO1: My annual budget includes an amount that allows me to check and ensure my spillway satisfies current safety standards	Oliver, 1991; Vogel, 1992; Albert, 1993; Dore, 2000; Roe, 2007 Campbell 2007; Pisaniello & McKay, 2007
				CAUS-ECO2: My annual budget includes an amount that allows me to maintain the safety of my dam as part of my dam management	
All	ModV	Institutional Environment		State (determined by phone number sampling) ranging from 1-weak and poorly integrated farm dam sustainability equity and safety elements to 4 – very strong and best practice integration of farm dam sustainability equity and safety elements	Raudenbush & Liu, 2000

5.4.2.2 Validity

Validity is a more abstract term than reliability and often refers to a measure being 'true' or 'correct' but really depends on the quality of the marriage of the conceptual and operational definitions of a construct (Neuman, 2006). The four main types of validity, face validity, content validity, criterion validity, and construct validity (Neuman, 2006) are addressed by this research. Firstly, face validity is the simplest validity that can be strived for and can be measured through the judgement of others in the scientific community (Neuman, 2006) which was addressed by this research by pretesting measures with academic colleagues (see Section 5.4.4.1), Secondly, content validity is concerned with measurement of the full definition of a construct being captured by a measure. This can also be achieved by expanding the breadth of a measure (Neuman, 2006). Content validity was addressed by using multiple indicators of a variable in an endeavour to capture the full measure (see

Table 5.2 which highlights the multiple items used to measure each variable). Thirdly, criterion validity can be concurrent, in that a measure agrees with an established measure, or predictive, in that it agrees with predictive behaviour (Neuman, 2006). This is addressed by using established measures wherever possible, especially for the dependent variable which is based on pre-existing literature in parallel areas of study, modified for the farm dam setting (see Table 5.2). Lastly, construct validity aims for consistency of multiple indicators in that they are *convergent*, that is, like ones are similar, or *discriminant,* that is different ones differ (Neuman, 2006). This is addressed through endeavouring to seek the full definition of a construct and its meaning and statistically testing convergence of measures onto a construct through factor analysis (see Section 5.5.1).

5.4.3 Scale development

Likert's (1932) method of summated ratings has been widely adopted because of its simple approach and its ability to capture different aspects of attitudes and behaviours (Manstead & Semin, 2001; Neuman, 2006). Typically respondents will respond on a 5-point scale rated from 'strongly agree' to 'strongly disagree' however evidence suggests that 6- and 7-point scales are optimal (Green & Rao, 1970). In addition, Nunnally (1978) who tested scales from 2- to 20-point found that reliability increases rapidly to a 7-point scale and then levels off to little incremental gain in reliability. Despite limited evidence that a midpoint on a scale can increase social desirability bias, it is ultimately the choice of the researcher to have a natural mid-point (Garland, 1991) and a 7-point scale was chosen with the following labels: 1-very strongly disagree, 2-strongly disagree, 3-disagree, 4-neutral, 5-agree, 6-strongly agree, 7-very strongly agree. There is much debate in the literature about treating ordinal scales (scales that identify the order in which data occurred, but not the distance between data points) as interval (data measured on a scale where intervals are equal) and vice versa (Grimm & Yarnold, 2002; Field, 2009). Ultimately, the researcher's beliefs about what is being measured are important and treating a Likert-type scale as interval is subjective (Grimm & Yarnold, 2002, p.9). There is also empirical evidence to support the treatment of these types of scales as if they were interval scales (Labovitz, 1970, p.515; alternative viewpoints argued by Zimmerman & Zumbo, 1993) which is the approach that has been assumed by this study.

5.4.4 Administering the survey

The survey was administered through a three-phase approach that enabled pre-testing on colleagues, pre-testing in the field, and actual implementation of the full final survey

instrument. Each step of survey administration, in addition to the considerations surrounding possible response rates, will be discussed in the following sections.

5.4.4.1 Pre-testing on colleagues

Once the farmer survey was developed, the need for pretesting was apparent before the instrument was sent into the field. Pretesting requires surveying a small group of respondents who are similar to the intended target group to determine their reactions to the prototype questionnaire. This achieves maximum clarity of the wording and translation of the technical terms used, most logical sequencing of questions, and the estimated length of the survey. The survey was trialled on three members of the scientific community to ensure logic and flow and to capture the required elements of each measure based on the real-world and research problem at hand. Changes were made to simplify wording throughout and removal of any potentially leading questions.

5.4.4.2 Pre-testing in the field

In August 2011 an initial pre-test of 28 surveys of farmers was undertaken. Results of the pre-test are ideally used as the basis for revisions in the questionnaire and logistical arrangements for the fieldwork. The pre-test allowed for reworking of the question order based on feedback from respondents and telephone interviewers, including the removal of three screening questions which were not required and also related to measures of dam size which were difficult in implementation with various metrics provided from respondents. The pre-test results were consistent and thus the survey was administered in the field. Results did not differ significantly from pre-test results and were included in the final analysis. The pre-test also facilitated improvement of the wording of the questionnaire and correction and improvement of the translation of technical terms, such as the terminology used for ‘farm dam’. The original research instrument used words such as ‘on-farm water storage’ and ‘storage structure’ with ‘farm dam’ interchangeably and this created confusion. The pre-test provided a means of catching and solving this unforeseen problem in the questionnaire, and thus the phrasing of alternative terms for ‘dams’ was eliminated in order to improve clarity and consistency.

5.4.4.3 Full survey implementation

Principles of good survey design were employed using Dillman’s (2000) Tailored Design Method. Thus, there was a script which included a preamble for informed consent (approved by UniSA Human Research Ethics Committee June 2011, Protocol #24946) to ensure that participants understood the nature and purpose of the research project and their involvement in it, and had understanding that they may withdraw from the research

project at any stage and that this would not affect their status now or in the future. Anonymity was also provided and the understanding that participants will not be identified and their personal results would remain confidential. During this process, several questions were reworded to be more neutral to reflect the intention of the research and although the potential for uncovering of violation of laws was held within the research, this would not result in any serious or unexpected adverse effects on research participants as the professional survey group were are under no obligation and have no intention to report any such violation. The professional surveyors also informed participants that they do not have to provide a response to any question if they do not wish to answer. The large battery of statement questions were then randomised to mitigate biased responses. The telephone script included a break at Question 12 ("I would now like you to tell me how much you agree or disagree with the following statements. Some of the statements may not be a perfect match with your situation but if you could offer an opinion that you feel is as close as possible, it would be appreciated") and at Question 80 ("Thank you for your patience-nearly finished"). Using a 7-point Likert scale was considered appropriate by the researcher for all questions in order to maximise the opportunity available to utilise first and/or second generation multivariate methods that require interval measures.

The first full round of surveys commenced in September 2011 and was administered by the professional survey group. The survey team are highly experienced at telephone interviewing using a computer-assisted telephone interview (CATI) system and thus were essential to achieving the maximum possible response rate for a survey of farmers that considered management styles and perceptions of pressures. The CATI system facilitates stratified probability sampling of the segmentation matrix, centralised data collection, standardised interviewer behaviour, and reduced survey costs (Fowler & Mangione, 1990; Groves, 1990; Vemuri *et al.*, 2011). The survey was 97 questions in length and took approximately 20 minutes to administer to each participant by the professional surveyors. Furthermore, the advantages of using an experienced telephone survey research team is that the professional approach results in a shorter data collection period, friendly professional surveyor administration (as opposed to mail surveys), better control and supervision of interviewers, and better response rate than mail for list samples (Kempf & Remington, 2007).

The telephone has provided critical access by researchers to examine population characteristics and cross-sectional properties of population subgroups to observe trends and behaviours and to identify perceptions and attitudes in health and other research fields (Kempf & Remington, 2007). Telephone surveys have the strength of face-to-face surveys

but for a fraction of the cost (Neuman, 2006). Survey researchers have benefited from improvements in professional survey firm technologies, such as CATI. However, there are also emerging challenges for phone survey research including the increased use of answering machines, caller ID, and mobile phones (Kempf & Remington, 2007). Kempf and Remington (2007, p.115) identify that the main purpose of phone surveys is:

> …to make valid, reliable, and generalizable conclusions about populations on the basis of the answers of sampled respondents. Therefore, surveys must first appropriately select participants from the target population, and then obtain valid information about the item of interest, such as an attitude, behavior, or health condition. Thorough and appropriate survey planning and administration are necessary to identify and prevent potential sources of selection and information bias.

This research identified phone numbers with higher probabilities of yielding a respondent which further improved the productivity and efficiency of the calling. Lavrakas (1993) identifies the main advantages of phone surveys over in-person, mail or email/internet sources, as the maintenance of quality control over the entire process and the speed of data collection. In addition, specific questions can be continuously monitored throughout the data collection process of a telephone survey, especially with the use of CATI systems such as employed for this study. Scheduling initial and repeat calls to potential respondents as this research assumed, serves the important purpose of increasing the efficiency of study administration by maximizing the return on the time spent calling (Kempf & Remington, 2007). The addition of the CATI system allowed for even greater efficiency by removing the human error associated with call scheduling as it provides an automated scheduling system. The system allowed for identification of important considerations in scheduling second and subsequent calls to farmers, such as inclusion of length of time between call attempts, the type of first contact, and variation in the timing and schedule of contacts which is important to maximise response rates (Kempf & Remington, 2007).

5.4.4.4 Response rates

Response rates are notoriously low for surveys of farmers and agriculture (Pennings *et al.*, 2002). Pennings *et al.* (2002) realised a response rate of 12%, for broad-scale farmer research, a lower figure than the typical response rates of 20% to 30% reported in the survey literature (Yammarino *et al.*, 1991). This is never more so than for mail surveys which is why the aforementioned telephone method was employed using expert telephone surveyors. A target response rate of at least 100 in each test state was set with response rate maximisation tactics of repeat call-backs with optimal call scheduling (Dillman, 2000). The literature strongly suggests a decline over time in response rates for phone surveys (Curtin *et al.*, 2005). This has been purported to be because of multiple factors including call screening, changing phone use patterns and refusals because of inundation (Kempf &

Remington, 2007). It is also suggested that although the potential for low response rates is dependent on the survey content and subject matter, response rates are vastly improved via phone method rather than mail or online alternatives. With many different types of farming industries and regions targeted, the most optimal time of year was not entirely possible to determine. However consideration was given to minimising significant specific industry or regional barriers and the survey time across August and September was considered most appropriate[5].

5.5 Analysis methods

The cross sectional study design incorporated statistical tests of validity, reliability and multiple regression analysis. The benefit of a cross-sectional study is that several groups of people can be observed at one point in time to examine differences between their behaviour at a point in time (Salkind, 1997). This study has adopted this approach in order to compare farm dam management behaviour under different farm dam institutional environment settings in four different states in Australia.

Cross-sectional research has the advantage of being inexpensive and short-term in terms of engagement as is usually necessary for complex multi-party analysis such as this (Salkind, 1997). Longitudinal data would be beneficial for drawing inferences from the study, however it was not possible in the time frame available with reliance on primary sources of data (that is, farmer surveys), rather than secondary (for example objective data), for which multiple years of data are often accessible. It is acknowledged that inferences must be drawn with caution when hypothesising about a point-in-time link between a farmer's environment and strategy (Bowen & Wiersema, 1999). In addition, attention is paid in this study to heteroscedasticity[6] which is an issue specific to cross-sectional research that must be addressed when considering strengthening validity of analysis (Bowen & Wiersema, 1999).

In the following sections, each of the important statistical tests of validity, reliability and multiple regression analysis are discussed in turn.

[5] For winter crops in Australia (Cereals, Grains, Legumes and Canola), busy times are planting from April to June and harvest from September to January (Agworkforce, 2012). For summer crops (Sorghum, Sunflowers, Soybeans) the busy times of the year are planting from September to January, and harvest from February to May (AgWorkforce, 2012). For dairy farmers, winter in Australia (June-August) is the busiest time of year for dairy which improves by September (AgWorkforce, 2012).

[6] Heteroscedasticity occurs when the residuals at each level of the independent variables have very unequal variances which can be problematic for linear modeling such as regression analysis (Field, 2009, see Chapter 6, Table 6.17 for assumption checking for regression analysis).

5.5.1 Validity testing – Factor analysis

Factor analysis is a data reduction technique that facilitates the determination of a small set of underpinning factors from a larger set of items (Coakes *et al.*, 2008; Field, 2009). This research employs factor analysis as an exploratory technique in the form of Exploratory Factor Analysis (EFA) as the study aims to summarise the structure of a set of variables developed based on theoretical constructs (Costello & Osborne, 2005). Factor analysis can be described by an equation, highlighted in Equation 5.1 for *n* variables. The equation is essentially describing a linear model with β representing factor loadings, and ε the random error or residual term. However, unlike a linear model, there is no intercept in the equation because the lines in a factor plot intersect at zero (Field, 2009).

Equation 5.1 – Factor analysis equation

$$\text{Factor} = \beta_1\text{Variable}_1 + \beta_2\text{Variable}_2 + \ldots\ldots + \beta_n\text{Variable}_n + \varepsilon$$

Factor analysis extends the concept of correlation so that a large array of intercorrelations where complex interactions exist between underlying elements can be analysed (Tinsley & Tinsley, 1987; Burns & Burns, 2008). Principal Components Analysis is a default method of extraction common to many statistical packages used as a data reduction method (Costello & Osborne, 2005). EFA allows the researcher to ensure the measures conceptualised based on the theoretical constructs and literature are in fact all validly measuring the same factor they are aiming to measure. The extraction method chosen for EFA is also important and warrants discussion here. There are several methods to choose from including maximum likelihood, principal axis factoring and generalised least squares (Field, 2009), each with relative strengths and weaknesses (see Costello & Osborne, 2005). However this study has chosen Principal Axis Factoring (PAF) because of its robustness to assumption violations (Fabrigar *et al.*, 1999) and ability to usually provide the best results for normal or slightly non-normal data (Costello & Osborne, 2005). Within EFA the choice must also be made for rotation method. Rotation does not improve the analysis but only clarifies the structure matrix that is created by EFA (Costello & Osborne, 2005). There are many options (see Field, 2009) however this study employs 'direct oblimin' which is a form of oblique rotation that allows the factors to correlate (as opposed to orthogonal that produces them uncorrelated, see Costello & Osborne, 2005). In reality, the researcher expects it to be likely that there will be some correlation between the factors, therefore oblique rotation is used for production of factor matrices that reveal correlations between factors (Field, 2009).

The assumptions of factor analysis to be discussed are presented in Table 5.3 and tested with results in Chapter 6.

Table 5.3 - Assumptions of EFA

	Assumption	Detail
1	Sample size	The sample size required for EFA is a minimum of 5 participants per item, preferably over n=200 (Coakes *et al.*, 2008; Tabachnick & Fidell, 2006).
2	Scale of Items	The scale should be interval or ratio (continuous) scale of measurement of items (Field, 2009).
3	Normality	The assumption of normality is a prerequisite although exploratory factor analysis is fairly robust to the test; it simply works better with normal data. This can be tested by observations of skew and kurtosis which should not reach critical non-normal levels of 2 and 7 (Muthen & Kaplan, 1985; 1992; Curran *et al.*, 1996).
4	Linearity	Because a factor analysis is based on correlations, the items must be linearly related to be able to load on factors and thus inter-item correlations should be at least above 0.2 (Field, 2009).
5	Outliers among cases or items	Checking for univariate outliers is especially important if non-normally distributed data is discovered upon checking skew and kurtosis values. Z-scores between -3.29 and +3.29 are considered normal (Field, 2009).
6	Multicollinearity and singularity	When items are highly correlated (correlations over 0.8) or even singular, meaning items are measuring the same dimension of a construct (correlations of 1.0) then they become redundant. Inter-item correlations are checked whilst running the EFA and any variables which have squared multiple corrections close to 1 should be excluded (Coakes *et al.*, 2008; Field, 2009).
7	Factorability	Having avoided multicollinearity and singularity at Assumption 6, now low correlations should also be located and if there are none above 0.3 then this is of concern as the factorability of the matrix (some items need to relate to each other to be 'factorable') will be reduced. In addition, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy* should be over 0.5 (Kaiser, 1974) and Bartlett's test of sphericity** should be significant (Field, 2009).

* The KMO is between 0 and 1 and represents the ratio of the squared correlation between variables to the squared partial correlation between variables. A value of 1 indicates that patterns of correlations are compact (the ratio is small) and factor analysis will be useful for yielding distinct factors (Field, 2009).

** Bartlett's test of sphericity tests the null hypothesis that the original correlation matrix is in fact an identity matrix. This needs to be significant to tell the researcher whether the group variances are the same within the variance-covariance matrix and the non-group variances are as close to 0 as possible (Field, 2009).

5.5.2 Reliability testing – Cronbach's alpha

Once a smaller set of items measuring a factor or dimension are determined, these can then be grouped together as a measurable variable. However, it initially has to be tested whether the items form a reliable scale when brought together. There are many different reliability coefficients however Cronbach's alpha is widely cited (see Cortina, 1993; Coakes *et al.*, 2008; Field, 2009) and useful because it is based on the average correlation of the items within a standardised test. More specifically, Cronbach's alpha is a 'measure of reliability that is equivalent to the average of all the split half correlations from all possible splits into halves of the items in the measuring instrument' (Burns & Burns, 2008, p.417). Effectively the measure is equivalent to splitting the data in half and computing a correlation coefficient for each half and then the average of these values corresponds to alpha (Field, 2009). Cronbach's alpha is measured with Equation 5.2 where k is the number of items, S^2_i is the variance of the $_i^{th}$ item and S^2_T is the variance of the total score formed by summing all the items (Bland & Altman, 1997).

Equation 5.2 – Cronbach's alpha equation

$$\alpha = (k/(k\text{-}1))(1\text{-}(\sum S^2_i/S^2_T))$$

A threshold of reliability for Cronbach's alpha is around 0.70, whilst 0.80 is ideal (Nunnally & Berstien, 1995; Bland & Altman, 1997; Field, 2009). However, alpha also depends on the number of items in a scale and can be acceptable as low as 0.5 with fewer items (Churchill & Peter, 1984; Cortina, 1993; Peterson, 1994)) and for preliminary studies in a new area or theoretical setting (Nunnally, 1967). The measure however can be influenced by design issues such as increasing the length of a survey (Burns & Burns, 2008, but this also has design problems, see Field, 2009) and this survey of approximately 20 minutes in length and 97 close ended questions is deemed to be long enough to achieve acceptability at an alpha of 0.5 if required. Because Cronbach's alpha is based on correlations, its assumptions are the same as for correlation. That is, interval measurement of items, normality, linearity and the absence of outliers, all of which have been discussed in section 5.5.1 for EFA and will be addressed in the results Chapter 6.

5.5.3 Hypotheses Testing - Multiple regression

The most appropriate methods selection is a critical phase of a research project (Stevens, 2002). First generation multivariate methods, like multiple regression, are extremely useful for prediction of variance in an interval dependent variable, based on linear combinations of independent variables (Tabachnick & Fidell, 2001). Multiple regression also allows for an interaction term to be added to the model to measure the joint effect of two variables on a dependent variable (Tabachnick & Fidell, 2001). Second generation multivariate methods like Structural Equation Modelling (SEM) (Fornell, 1987; Chin, 1998), by contrast, allow simultaneous analysis of all the variables in the model instead of separately and measurement error is not aggregated in a residual error term. Both multiple regression and SEM share the same mathematical basis, but their application is contextual (Nusair & Hua, 2010). However, SEM models are prone to nonconvergence and improper solutions because of their complicated constraints (Ping, 1998; Dalal & Zickar, 2012). A model only converges when the values of the unknown parameters are sufficiently close to the convergence criterion (Bollen, 1989), then if there are many indicators (that is, many unknown parameters), the model is not likely to converge (Ping, 1995; 1996; 1998). Furthermore, when testing for moderation, SEM requires a multi-group approach to compare changes across groups and thus information is lost (Bagozzi & Yi, 2012). If a significant interaction is not found then the moderating model is rejected, however with moderated multiple regression, individual interactions may be significant and there may be a case to claim a moderating effect (Bagozzi & Yi, 2012).

The limitations of multiple regression are well-known (see Ragin, 1987 for discussion) and it is acknowledged that other methods may also be appropriate for the study, especially

given the sample size. Consideration was given to the literature surrounding the benefits of simple, non-optimised coefficients (e.g., correlation weights, equal weights) (Dana & Dawes, 2004), scatter-plots (Cameron, 1984; King *et al*., 2000), and even simpler descriptive statistics (Abbott, 1998). However, the limitations to multiple regression are not considered enough of a basis to eliminate it from the study and ultimately, the choice to use moderated multiple regression in this study is based on the novel area under investigation, in addition to the research questions that require moderation of an additional environmental variable for prediction of a likelihood or probability of response (Nusair & Hua, 2010).

Multiple regression is a tool that allows for prediction of variance in a dependent variable, based on linear combinations of independent variables. Parameter estimates in multiple regression are the unstandardised regression coefficients (β weights) as highlighted in Equation 5.3 where Y is the dependent variable, β_0 is the least-squares estimate of the intercept, β_1 is the least-squares estimate of the population regression coefficient for X, where X is the value of the first independent variable, β_2 is the least-squares estimate of the population regression coefficient for Z, where Z is the value of the second independent variable, and ε is the random error or residual term (Aguinis, 1995; Cohen *et al*., 2003).

Equation 5.3 – Multiple regression equation with two continuous predictors

$$Y = \beta_0 + \beta_1 X + \beta_2 Z + \varepsilon$$

The value β_1 represents the amount the dependent variable Y changes when the independent variables changes by one unit while the other independent variables are held constant and so forth for each independent variable and the interaction term (Field, 2009). The proportion of the variance in the dependent variable explained by the independent variables in the model is the coefficient of multiple determination, or R^2 and the F test is used to test the significance of R^2 (Field, 2009).

5.5.3.1 Assumptions of multiple regression

The assumptions and design issues that relate to multiple regression (see Berry, 1993) are presented in Table 5.4 and discussed further in Chapter 6 where the results are presented (Section 6.4).

Table 5.4 - Assumptions of multiple regression

	Assumption	Detail
1	Variable types	The variables must be interval or categorical (two categories), with an interval dependent variable measure with logical relationships identified as plausible by the literature in the surrounding area (Berry, 1993).
2	Ratio of cases to independent variables – sample size	When m represents the number of independent variables, it is recommended that the minimum sample size be calculated as the highest of either n>50 +8m or n>104+m (Tabachnick & Fidell, 2001).
3	Normality of dependent and independent variables	Normality enhances the solution as it is based on correlations. Skew and kurtosis are commonly used indicators of normality. Studies suggest that that skew and kurtosis become problematic for multivariate analysis when they reach values of 2 and 7 respectively (Field, 2009).
4	Linearity	Because multiple regressions are based on correlations, the items should be linearly related and the amount of scatter around the line should not vary dramatically (Burns & Burns, 2008).
5	Outliers on dependent variable and among independent variables	Outliers can indicate non-normality and univariate outliers indicating outliers among items can be detected via z-scores (Burns & Burns, 2008). Z-scores are standardised values that are the values divided by an estimate of their standard deviation in order to create a standard measure of what is acceptable within the data set. In a normally distributed sample, 99.9% of cases should lie between -3.29 and +3.29 (Field, 2009). Multivariate outliers suggest that the individual is responding differently compared to other participants across multiple dimensions. Specifically, they are cases with extreme scores on two or more variables (Tabachnick & Fidell, 2001). Multivariate outliers can be evaluated based on Mahalanobis distance values which measures the distance of cases from the means of the independent variables (Tabachnick & Fidell, 2001). However, it is difficult to determine appropriate cut off point however Barnett and Lewis (1978) endeavoured to produce a table of critical values and found that in sample sizes of the critical Chi-square value of $X^2(18)=42.31$, $p<0.001$ was considered the cut-off for Mahalanobis distance values (Tabachnick & Fidell, 2001).
6	Multicollinearity and singularity	When independent variables are too highly correlated they become redundant and should thus have correlations less than 0.8 (Tabachnick & Fidell, 2001). In addition, Tolerance statics above 0.2 and Variance Inflation Factors below 10 are best (Field, 2009).
7	Normality, Linearity, and Homoscedasticity of Residuals	Residuals represent the difference between the value a model predicts and the value observed (represented by the actual data) (Field, 2009). This assumption can be checked visually on a histogram, scatterplot and normal probability plot (P-P) of the residuals. The histogram, which is a graph plotting values of observations of the residuals on the horizontal axis and the frequency with which they occur on the Y axis should show a normal distribution (bell-shaped curve) (Field, 2009). The scatterplot plots the residuals of the dependent variable against the independent variables and should show even dispersion of dots. Any sort of curve in this graph can violate linearity of residuals and if the graph funnels out, there can be heteroscedasticity* of residuals (Field, 2009). The Normal P-P graph plots the cumulative probability of the normal distribution of residuals and values should fall on this line on the diagonal, indicating the variable's residuals share the same distribution as the distribution specified and if they do not, they show deviation from the distribution that is of interest to the study (Field, 2009).

* Heteroscedasticity occurs when the residuals at each level of the independent variables have unequal variances as opposed to homoscedasticity which means at each point along any independent variable, the spread of residuals is fairly constant (Field, 2009).

The next section discusses the specific type of multiple regression used for this study based on the type of variables and questions for analyses.

5.5.3.2 Moderated Multiple Regression

Multiple regression is based on bivariate correlation however the regression equation is able to go further than correlation (which describes the existence and strength of relationships) to predict a dependent variable based on several independent variables (Coakes *et al.*, 2008). Interaction terms may be added to the model to measure the joint effect of two variables on a dependent variable, for example, the moderating effect of an

additional variable, in this case, the institutional environment (Prescott, 1986). Modelling moderation can lead to deeper comprehensive knowledge about a research problem by 'providing information about the conditions under which the two variables will be associated' (Rose *et al.,* 2004). Because the study conceptual model (see Chapter 4, Figure 4.1) contains a moderating variable which is predicted to affect the nature of the relationship between the dependent and independent variables (Burns & Burns, 2008), a Moderated Multiple Regression (MMR) will be undertaken as part of the regression analyses. There have been claims that testing moderating, or interacting variables is at the 'heart of scientific enterprise' (Hall & Rosenthal, 1991) and thus moderated multiple regression (MMR) was developed in order to test moderating effects (Saunders, 1956; Cohen & Cohen, 1983; Aguinis, 1995).

Moderating a regression with a variable such as environment, is popular in strategy research: Jauch *et al*. (1980) test environmental changes on the relationship between strategic decisions and performance; Boulton *et al*. (1982) examined uncertainty as a moderator of the relationship between industry groups in different environments; Hitt *et al*. (1982) examined the moderating effects of strategy and type of industry on the strategic importance of functional areas and company performance; and Prescott (1986) used moderation to test changes in the strength of relationships between strategy and performance. More recently, the prevalence of moderating relationships in organisational research is noted by Dalal and Zickar (2012) who highlight that from 2000 – 2010, 118 articles including moderating effects appeared in the *Journal of Applied Psychology*; 56 such articles were in *Academy of Management Journal;* and 23 empirical studies including moderated relationships could be found in *Personnel Psychology*.

The institutional environment (ModV) has been hypothesised at different levels to influence the relationship between the independent variables and dependent variable. In this case it is possible to standardise the independent variable and the moderating variable and combine to create an interaction term (Evans, 1985). The resulting interaction term, in addition to the independent variables, dependent variables and the moderator, can then be included in a hierarchical regression to test the relationships themselves plus the hypothesised moderation effects on the relationships. It is important to note here that a moderating effect is distinct from a mediating effect: a mediating variable is positioned in the path of the variables and is part of a causal chain (Baron & Kenny, 1986). This study does not hypothesise that the institutional environment is a necessary variable for the independent variable to have an effect on the dependent variable, but rather that the institutional environment will affect the strength of the relationship. Equation 5.4 shows

how MMR allows the researcher not only to test the main effects of the relationship between two variables (for example, *X* and *Y*) but also the variation caused by the value of the third variable – the moderator (for example, *Z*) (Zedeck, 1971; Aguinis, 1995).

Equation 5.4 – Moderated multiple regression equation

$$Y = \beta_0 + \beta_1 X + \beta_2 Z + \beta_3 XZ + \varepsilon$$

Where *Y* is the dependent variable, β_0 is the least-squares estimate of the intercept, β_1 is the least-squares estimate of the population regression coefficient for *X*, where *X* is the value of the first independent variable, β_2 is the least-squares estimate of the population regression coefficient for *Z,* where *Z* is the value of the second independent variable, β_3 is the least-squares estimate of the population regression coefficient for *XZ,* which is the interaction term or the product between the two predictors, and ε is the random error or residual term (Aguinis, 1995; Irwin & McClelland, 2001; Cohen *et al.*, 2003). The value β_1 represents the amount the dependent variable *Y* changes when the independent variables changes by one unit while the other independent variables are held constant and so forth for each independent variable and the interaction term (Field, 2009).

The proportion of the variance in the dependent variable explained by the new interaction term between the independent variables in the new model (*XZ*), entered hierarchically (Arnold & Evans, 1979; Arnold, 1982) is the coefficient of multiple determination changed, or R^2 change and the *F* test change is used to test the significance (Field, 2009). The better fitting model can be determined by comparing the difference between the *R*-squares when the interaction term is added. Relative predictive importance of the independent variables is assessed by comparing the standardized regression coefficients (beta weights). In order to create the interaction term, each independent variable must be centred or standardised (Dunlap & Kemery, 1987). This study adopts the standardised approach and combines the *z*-scores for each variable to ensure that the error of each term does not accumulate (Aguinis, 1993).

The assumptions for ordinary multiple regression hold for MMR however, there have been difficulties with the use of MMR (Aguinis, 1993) and threats to statistical power that can arise when Type II statistical errors[7] are high and researchers reject theoretical models that may in fact include moderating effects (Aguinis, 1995). The main elements that are detrimental to statistical power in MMR are (1) poor variable distributions, (2) measurement

[7] Type II statistical errors occur when the researcher believes there is no effect in the population when there really is, as opposed to Type I statistical errors that arise when the research believes that there is a genuine effect in the population when there is not (Field, 2009).

error, (3) small sample size, and (4) predictor inter-correlation (Aguinis, 1995). This study endeavours to overcome these problems via (1) adoption of random, unbiased stratified sampling (McClelland & Judd, 1993), (2) endeavouring to only include variables with as high as possible inter-item reliability (Cohen, 1988 recommends as high as possible without getting too close to 0.8 (suggesting multicollinearity), see Chapter 6, Section 6.3 for results of Cronbach's alpha reliability testing included in overall variable validity and reliability assessments), (3) selection of a large sample size (that is, larger than n=100, Aguinis, 1995), and (4) standardising all interaction terms to test moderation before combining to avoid multicollinearity of predictors becoming a problem (Aguinis, 1995, see Chapter 6, Section 6.4.1.2 for a description of this process). Although the process has been acknowledged to be imperfect (Aguinis, 1995) it is the preferred statistical method for detecting moderating effects, especially in models with continuous predictor variables (Cohen & Cohen, 1983; Cohen *et al.*, 2003) such as this study.

5.6 Summary

The survey research method adopted for this thesis was a telephone survey with data collected using an instrument developed through a review of the related literature (Chapter 2), a review of the pressures in the sustainable farm dam management institutional environment (Chapter 3), and identification of the institutional pressures that can create resistance to sustainable farm dam management pressure (Chapter 4). Methods for testing construct reliability and validity were revealed in this chapter and the next chapter will outline the results of these tests, in addition to results of testing their assumptions. Hypothesis testing will be undertaken in the following chapter using multiple regression analyses as described in this chapter.

Chapter 6

Farmers' perceptions of sustainable farm dam management pressures in relation to the institutional environment

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6.1 Introduction

This chapter presents the statistical tests of the relationship between farmers' perceptions of sustainable farm dam management institutional pressures and their resistance to those pressures. That is, Research Problem 3 is addressed in order to provide understanding of the potential for farmer resistance to surface water storage pressures and contribute toward answering sub-Research Question 3 which asks, *How are farmers' perceptions of sustainable farm dam management related to the institutional environment and the potential for farmer resistance to the surface water storage pressures?*

The hypotheses contained in Chapter 4 will be tested in this chapter to examine how farmers will respond to elements of the perceived context (IV1), control (IV2), content (IV3), constituents (IV4), and cause (IV5) of institutional pressures from their environment. The moderating effect of the sustainable farm dam management institutional environment (ModV) will also be examined for its moderating effects, and also on all modelling of the dependent variables through regression analysis of each state separately for comparison. These results are presented in detail in the following sections and discussed further in Chapter 7 against the specific hypotheses of Chapter 4. This chapter also reveals the results of validity and reliability testing of variables. Processes and assumptions of all statistical tests are discussed and results provided. Firstly, the response rates achieved are presented and key details about the sample described before presentation of the statistical results.

6.2 Sample

Farmers are responsible for managing farm dams and are subject to associated pressures from the institutional environment. Therefore, in order to answer Research Question 3, the focus needs to be on measurement of perceptions of farmers as the representative of the organisation (farm). Sampling of farmers was undertaken from industries and regions where catchment dams exist (see Chapter 5, Section 5.3.1, for discussion of the nature of catchment dams). The response rate realised and sample profile are discussed in the following sections respectively.

6.2.1 Response rate

The high quality sampling of farmers from industries and regions where catchment dams exist is reflected by the response rates achieved in the four test states (Table 6.1). The target completion rate of at least 100 interviews in each test state was established across all classes of the segmentation of appropriate random sampling of industry and region. As a result, the study was able to realise a sample size adequate for quantitative multivariate analysis and comparison. The total sample size for the four test states was *n*=404 with 100 respondents in South Australia, 102 in New South Wales, 102 in Victoria, and 100 in Tasmania.

Table 6.1 Study response rates

Test State	**Random sampling of organisations with potential for managing catchment dams** (sampling frame)	**Number of phone numbers answered/accessible** (available sampling frame)	**Number of farmer representative telephone surveys completed** (sample)	**Farmer response rate %**
South Australia	790	304	100	33
New South Wales	942	397	102	26
Victoria	1,169	421	102	24
Tasmania	578	234	100	43
TOTAL	3,479	1,356	404	30

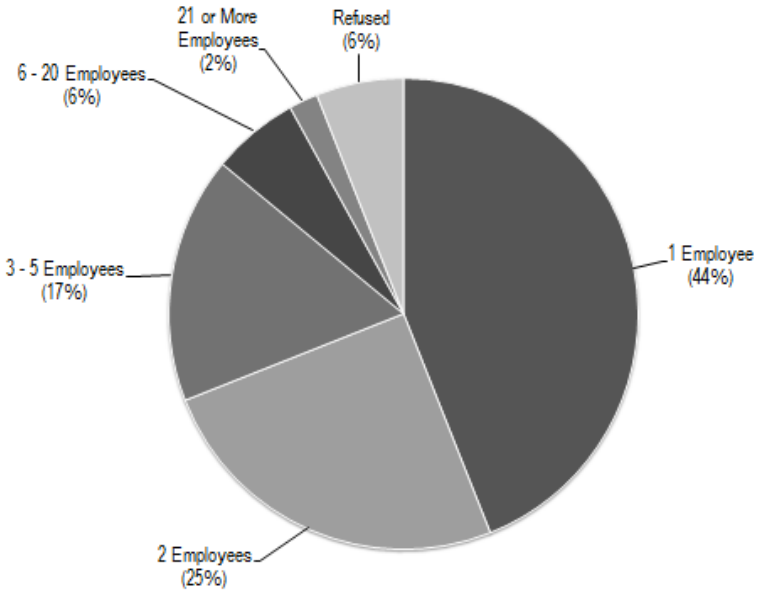
As highlighted in Table 6.1, a response rate of 30% was realised from the available sampling frame. The overall response rate is comparable to, or higher than, that commonly reported in the management literature (for example, Boulton *et al.*, 1982 (29%); Delery and Doty, 1996 (21%), Youndt *et al.*, 1996 (31%); Richard, 2000 (20%)). By test state, the response rate was 33% from South Australia, 26% from New South Wales, 24% from Victoria, and 43% from Tasmania. With response rates notoriously low in the agricultural sector (Pennings *et al.*, 2002), the response rates attained of between 26% and 43% are highly satisfactory, especially as the survey was to take 20 minutes and there was no incentive offered for participation. The response rate is therefore considered adequate for generalizability of results to the study population of farmers with catchment dams in the four Australian test states.

6.2.2 Sample profile

The study focused on farm dam owners or managers positioned within a catchment which is where the cumulative potential for unfair sharing and unsafe storage of water exists. Therefore, inferences from this analysis are made to farm dam owner/managers with catchment dams (usually in gently or considerably undulating topography, Pisaniello, 1997), rather than farm dam owners/managers in general. Dam owners/managers or 'farmers' perceptions were chosen as the unit of analysis because they represent the

organisation (see Chapter 2, Section 2.4), and because farmers are often part of, or solely responsible for, a small organisation in terms of employee numbers, where it is likely that their views represent that of the entire organisation (Australia.gov.au, 2011; NFF, 2012). Figure 6.1 supports this notion of the farmer's views being representative, with 44% of farms in the sample having only one employee, and a further 25% with only two employees.

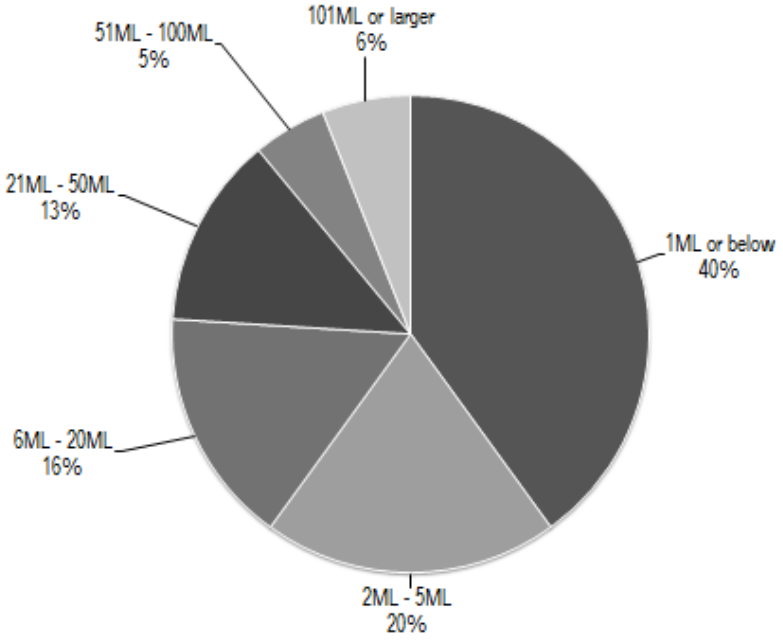
Figure 6.1 – Size of farm represented by number of employees



Chapter 2 described the importance of sustainable management of small farm dams because they can share water unfairly and be unsafe, especially on a cumulative scale (see Chapter 2, Section 2.3.2.1 (equity) and Section 2.3.2.2 (safety)). In a strong sustainable farm dam management institutional environment, small farm dams will be captured by equity and safety institutional mechanisms (Chapter 3, see Section 3.5.3). The results support the importance of sustainable farm dam management institutional mechanisms for small dams with 76% of farmers identifying their largest dam as 20ML or below, confirming that the majority of farm dams in the sample are, in fact, small and thus attention to their potential for water sharing inequity or unsafe storage of water is warranted, especially on a cumulative scale[8].

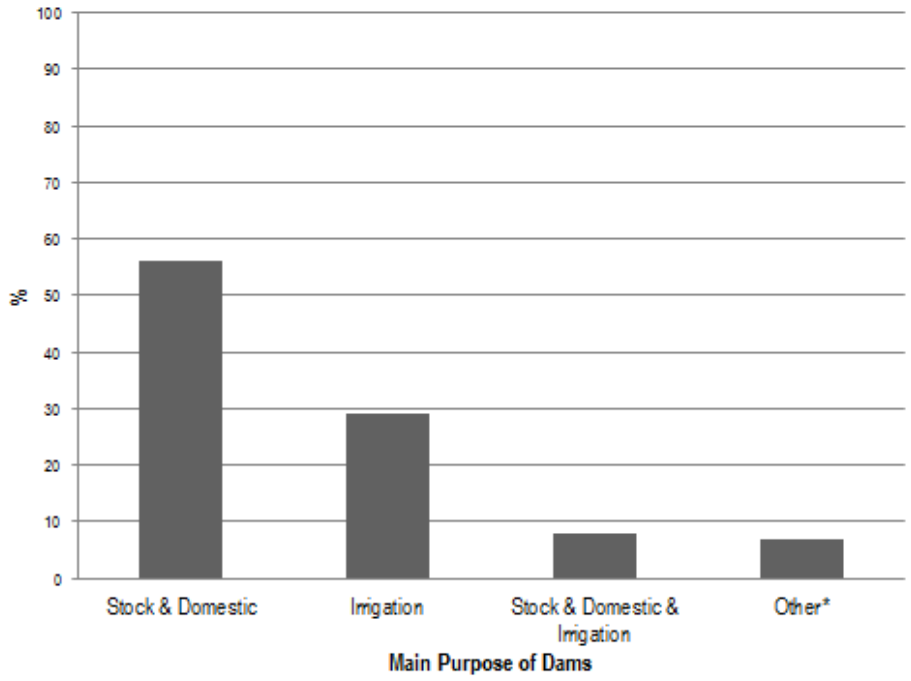
[8] It should be noted that 99.5% of dams in the sample are 'small' in relation to ANCOLD's size classification which generally considers dams less than 1000ML in capacity to be 'small' (ANCOLD, 1986). It should also be mentioned that ANCOLD (1986) indicates that a dam can only be classified as being of 'referable' size for stand-alone flood safety threat if it has a storage capacity ≥ 20ML (Victoria's safety policy is based on this guideline, see thesis Section 3.4.3.5). But ANCOLD (2000a, p.10) also indicates that any size dams combined, may contribute to cumulative style hazards/threats in which case they are also worthy of attention – this is why Tasmania's safety policy captures dams ≥ 1 ML (see thesis Section 3.4.3.6 and Pisaniello *et al*., 2012).

Figure 6.2 - Size of the largest dam of farmers surveyed



Furthermore, as highlighted by Figure 6.3, over half of the farmers surveyed (56%) identify the main purpose of their dam(s) as 'stock and domestic' water use, which are usually smaller dams (see Chapter 2, Section 2.4.4.3 for discussion of the nature of small farm dams).

Figure 6.3 - Main purpose of farm dams

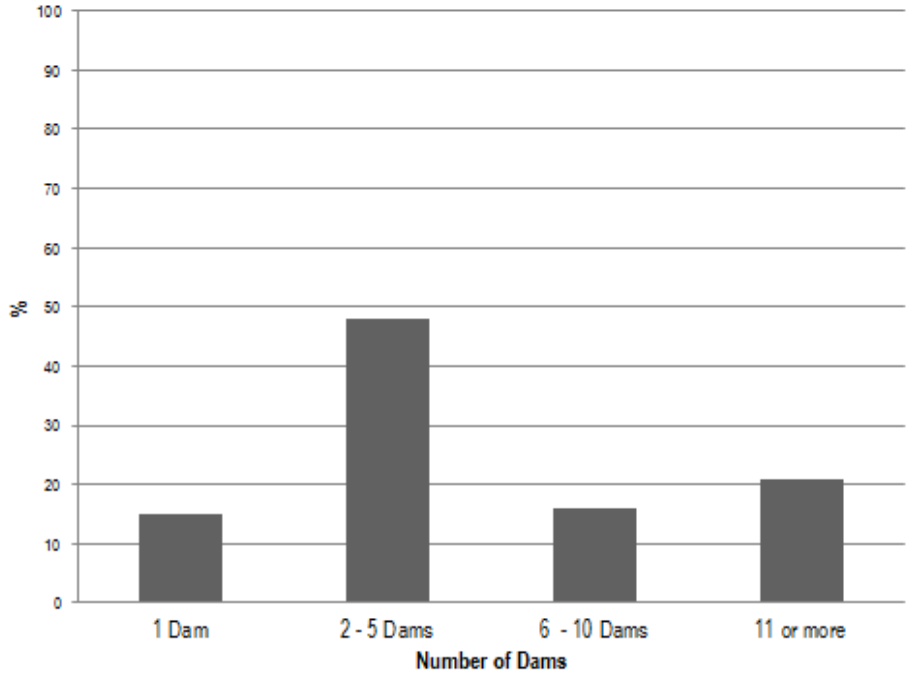


*The 7% of 'other' purpose farm dams are identified by farmers as water storage for fire fighting, yabby breading, aesthetics, recreation, dairy block washing, erosion control, and those not in use for any purpose.

Figure 6.4 highlights that farmers usually have more than one dam, in fact 20% of farmers surveyed are responsible for more than eleven dams. Therefore the potential for a

cumulative scenario exists not only between farms but within farms, exacerbating any inequitable or unsafe situation if a farmer manages all dams unsustainably.

Figure 6.4 – Number of farm dams for each farmer in sample



The above descriptive statistics provide overview of the sample as it relates to the size of the farming organisation, the size of the dams and the purpose of the dams. Following is analysis and presentation of questionnaire item validity and reliability data, and tests of hypotheses, which were analysed using Statistical Package for the Social Sciences (SPSS), version 18.0.

6.3 Statistical validity and reliability

Because this research relates to the quantification of intangible and unobservable constructs, validity and reliability are two important characteristics of measures, especially as they relate to gathering data on perceptions. The following sections discuss the statistical testing of validity and reliability and resulting formulation of testable variables based on these results.

6.3.1 Validity testing: Exploratory factor analysis

Exploratory Factor Analysis (EFA) was employed as the analytic method for condensation of the groups of empirical indicators into smaller sets of composite factors (latent variables) with minimum loss of information (Hair *et al*., 1992). An exploratory factor analysis (EFA)

was undertaken with Principal Axis Factoring and Direct Oblimin rotation (see Chapter 5, section 5.7.1 for discussion of this type of EFA which is robust to violations of assumptions and also allows the factors to correlate). However, the assumptions of factor analysis have to be met prior to undertaking testing. The assumptions listed in Chapter 5, Section 5.5.1 have been addressed with results described in Table 6.2. As highlighted in the table, data related to assumption checking is available in Appendix 4 and 5).

Table - 6.2 Assumption checking: EFA

	Assumption	Detail
1	Sample size	With 78 items to be placed into factor analysis testing for the underlying variables, this study of 404 participants, adequately meets the robust minimum sample size required (of 5 x number independent variables =390).
2	Scale of Items	This research assumes the 7-point Likert scale to be interval (see Chapter 5, Section 5.5.1.2 for justification and further discussion).
3	Normality	Skew and kurtosis measures are included in Appendix 4 and items that fall outside of 2 (skew) and 7 (kurtosis) (Curran *et al.*, 1996) given attention. Most items appear normally distributed however there was one item for concern: CONST-SUB5 ('I have changed my dam management practice because of an article in the media'), with kurtosis of 8.23. This item has been flagged but no further action taken at this point because of the robustness of EFA to problems of normality. This item will be considered in further stages of analysis.
4	Linearity	This assumption is tested and discussed for each variable separately through inspection of inter-item correlations (see Appendix 5) at the time of running the EFA. The results are presented in Section 6.3.3 following.
5	Outliers among cases or items	All the data were screened for outliers using standardised testing in the form of *z*-scores, the results for each variable are presented in Appendix 4, in conjunction with the results of skew and kurtosis. There were some items that fell outside of the normal range of -3.29 to +3.29. Anything beyond -4 + 4 was considered a disruptive outlier – no items were removed.
6	Multicollinearity and singularity	This assumption is tested and discussed for each variable separately through inspection of inter-item correlations (see Appendix 5) at the time of running the EFA. The results are presented in Section 6.3.3 following.
7	Factorability	This assumption is tested and discussed for each variable separately at the time of running the EFA through inspection of communalities (see Appendix 5), KMO and Bartlett's tests. The results are presented in Section 6.3.3 following.

The subsequent undertaking of the EFAs required multiple items to be deleted from several of the constructs, particularly the independent variables, which enabled condensing of the construct into the underlying measures that represent it statistically. Several single-item constructs emerged, the use of which is discussed further in Section 6.3.3.6. Also, legal coercion was found to have two underlying constructs and was separated into the dimensions of 'Action' and 'Threat' which will be discussed further in Section 6.3.3.8.

6.3.2 Reliability testing: Cronbach's alpha

Reliability testing was undertaken of each scale developed resulting from the EFA using the measure of Cronbach's alpha. The results are presented for each variable in section 6.3.3 combined with the results of the EFA for scale development. The assumptions for Cronbach's alpha are met by meeting the assumptions for EFA above, that is: (1) Interval measurement of items (EFA Assumption 2), (2) normality (EFA Assumption 3), (3) linearity (EFA Assumption 4), and (4) the absence of outliers (EFA Assumption 5).

6.3.3 Variable validity and reliability

The factor analysis and reliability testing (Cronbach's alpha) are discussed in the following sections by variable. The items designed to measure each variable are presented to determine how many and which items can be retained for the final analysis from statistical validity and reliability testing. For each variable, the items that are retained appear in bold.

6.3.3.1 Dependent variable: Acquiescence

Acquiescence is the dependent variable that represents the lowest level of farmer resistance to sustainable farm dam management institutional pressure. Six items were designed to measure all dimensions of the acquiescence variable, however only four were ultimately retained. The following discussion details the assumption testing for the acquiescence EFA, the results of the undertaking of the EFA, followed by Cronbach's alpha reliability testing.

Each of the six items designed to measure the variable acquiescence had skew and kurtosis within the acceptable range of between -2 and +2 and -7 and +7 respectively and the *z*-scores for the items fell between -2.77 and +2.41 which was acceptable to assume normality and the absence of univariate outliers (Field, 2009). Outlier items were not identified by communalities although ACQU1 did demonstrate that it did not have much in common with the other factors with an initial communality of 0.02. The inter-item correlations did not show evidence of multicollinearity (>0.8) or singularity (that is, correlations of 1). Inter-item correlations of over 0.2 are usually desirable to suggest that the items are linearly related and the matrix is factorable. ACQU3 had one low correlation with other items, items ACQU1 and ACQU2 shared several disturbingly low correlations throughout the matrix of below 0.1 and ACQU6 even had a negative correlation. However, it was decided to retain all items at this point.

Additional tests of factorability of the matrix included a Kaiser-Meyer-Olkin (KMO) test of sampling adequacy which was good at 0.62 and Bartlett's test of sphericity was significant (X^2=263.74, p<0.001) indicating that it was suitable to proceed with the factor analysis. The solution was initially two factors, the first explaining 23.76% of variance and the second explaining 10.37%. This combination did not explain a great amount of the variance so the factor matrix was analysed which indicated that ACQU1 did not load (only showing loadings over 0.40 otherwise too small to be crucial to any factor) and ACQU6 cross-loaded. It was then decided, in combination with the above problems with communalities and correlations of these items, that they should be removed. The subsequent communalities were improved and the KMO test of sampling adequacy

remained good at 0.63 and Bartlett's test of sphericity X^2=193.45, p<0.001 remained significant, suggesting factorability of the matrix was retained with the removal of the two items. A single factor solution was realised and initial eigenvalues explained 45.67% of the variance, supported by the scree plot visually indicating the presence of only a single factor above the elbow. The total variance explained by the factor was 31.72%.

Cronbach's alpha calculation was undertaken to determine the reliability of the scale. The result for this scale was 0.59 which is adequate for the number of items (#items=3). Item-total statistics suggest that deletion of ACQU5 would only improve the alpha value marginally to 0.64 thus in combination with the other calculations, and the knowledge that the nature of this item captures the important dimension of regulation, it was decided to retain this item as part of the final scale for acquiescence. The final scale was included in the compute new variable function in SPSS to calculate the means of all the items comprising the score, to create the new variable of 'Acquiescence' for use in the final analysis (Table 6.3).

Table 6.3 - Items designed to measure acquiescence

Variable	Items designed to measure and items retained in actual measure (in bold)
Acquiescence	ACQU1: I manage my dam in the same way we always have on this farm
	ACQU2: I speak with others who work on the farm and adopt the best farm dam management approach used in the past
	ACQU3: I speak with others who work on the farm about the best farm dam management approach they currently recommend and adopt that approach
	ACQU4: I follow the dam management approach that is used by other successful farmers in the area
	ACQU5: I make a conscious evaluation of specific dam laws and choose to comply with them
	ACQU6: I communicate with the regulators to determine the best way to comply with the spirit and intent of the dam management laws

6.3.3.2 Dependent variable: Compromise

Still in the spectrum of low farmer resistance to institutional pressure, is the dependent variable compromise. Six items were designed to measure compromise, and all six were ultimately retained as measuring the underlying meaning of the variable. The assumption testing, EFA, and reliability testing of the six items as one construct are detailed as follows.

The skew and kurtosis for all six initial items comprising the variable compromise fell within an acceptable range for normal. *Z*-scores fell between -3.17 and +2.73 suggesting the absence of univariate outliers. The inter-item correlations showed no correlations over 0.8 (suggests multicollinearity) or at 0.1 (suggests singularity) however all were close enough to 0.3 for tests of linearity. The communalities for all items were adequate to indicate each item had sufficient in common with the other items and a further test of factorability returned good results with KMO's test of sampling adequacy at 0.77 and Bartlett's test of

Sphericity significant (X^2=455.44, p<0.001). The single factor solution had initial eigenvalues explaining 43.25% of the variable and a scree plot visually supporting the presence of one factor. The total variance explained was 32.56%.

Cronbach's alpha test of reliability of the scale returned 0.73 which is a highly satisfactory result, and the item total statistics suggesting that no item need be deleted to improve the alpha score. Thus, all items were retained as a valid and reliable scale and computed in SPSS to create the new variable 'Compromise' (Table 6.4).

Table 6.4 - Items designed to measure compromise

Variable	Items designed to measure and items retained in actual measure (in bold)
Compromise	**COMP1: I negotiate openly with the regulators to obtain a mutually agreeable solution on management of my dam**
	COMP2: I obtain consensus with the regulators about my farm dam management for the benefit of communities downstream
	COMP3: I negotiate with the regulators to obtain an advantageous dam management situation for the community downstream
	COMP4: I bargain with the regulators to obtain a favourable dam management situation for the community downstream
	COMP5: I partially conform with the specific dam management laws that are most important to the regulators
	COMP6: I determine the most important elements of dam management for regulators and agree to comply

6.3.3.3 Dependent variable: Avoidance

Avoidance is the dependent variable that represents mid-range farmer resistance to sustainable farm dam management institutional pressure. Six items were designed to capture the underlying meaning of the avoidance variable. Ultimately, five items were retained. The following discussion details the assumption testing of the items designed to measure avoidance, results of the EFA, followed by reliability testing through Cronbach's alpha.

For the six items designed to measure avoidance, skew and kurtosis all fell within the normal range of -2 to +2 and -7 to +7 respectively. Signs of univariate outliers were not recognised with z-scores falling within the range of -3.46 and +2.90 for all items. Communalities were acceptable for all items (above 0.2) but AVOID4 had a very low amount in common with other items returning an initial score of 0.07. It was decided to proceed at this point with this item flagged for further indications of problems. KMO's test of sampling adequacy (0.69) and Bartlett's test of sphericity (X^2=184.62, p<0.001) both indicated that the matrix was factorable and it was suitable to proceed. The initial inter-item correlations returned no signs of singularity or multicollinearity however item AVOID4 had low correlation with both AVOID2 and AVOID3, returning scores of only 0.07 and 0.06 respectively (see Table 6.5 for items). The initial two factor solution contained the first

factor explaining 20.12% and the second explaining 5.67% which was very low. In addition, the scree plot was undulating with no clear differentiation above the elbow. The factor matrix supported the initial findings in the communalities with AVOID4 not loaded (indicating a score of below 0.40). Item AVOID4 was then deleted and the exploratory factor analysis re-run. The new KMO's test of sampling adequacy (0.70) was improved and Bartlett's test of sphericity (X^2=154.339, p<0.001) retained significance suggesting that factorability of the matrix was retained and even improved. Communalities between items were improved except for AVOID1 which was reduced to 0.07 however it was decided to retain the item because of its nexus to the theme of the variable, particularly the use of the word 'avoid'. The single factor solution that was generated had a clear scree plot with one factor loading above the elbow in addition to initial eigenvalues explaining 37.28% of variance. The total variance explained was still quite low at 22.25% however all items are validly measuring the same construct and loading strongly on one factor in the factor matrices.

Cronbach's alpha returned a score of 0.56 which is acceptable to suggest reliability of the resulting scale and would only improve by 0.01 if AVOID1 was deleted so this item was retained. The 'Avoidance' dependent variable was then computed in SPSS to include the means of all the comprising items for inclusion in the final analysis (Table 6.5).

Table 6.5 - Items designed to measure avoidance

Variable	Items designed to measure and items retained in actual measure (in bold)
Avoidance	**AVOID1: I appear to comply with dam management laws but intentionally avoid certain aspects of the requirements**
	AVOID2: I conceal certain aspects of my farm dam management from the regulators
	AVOID3: I purposefully block my spillway to build up my water supply
	AVOID4: I avoid in dealing with any industry bodies that are worried about dam management
	AVOID5: I would consider moving spillway blockages to avoid detection by regulators
	AVOID6: I would consider growing intense vegetation near the dam to remove access to regulators

6.3.3.4 Dependent variable: Defiance

In the spectrum of high farmer resistance to sustainable farm dam management institutional pressure, is the dependent variable defiance. As with all of the dependent variables, six items were designed to measure defiance, and four items were ultimately retained as measuring the underlying meaning of the variable. The assumption testing, EFA, and reliability testing of the four items as one construct are detailed as follows.

For the variable defiance, the skew and kurtosis values for all items occurred within the acceptable range and the *z*-scores between -2.97 and +1.92 are also appropriate to assume normality and the absence of univariate outliers. Communalities among items

designed to measure defiance were all adequate around 0.3 except for DEFI1 which had an initial communality value of 0.1. Inter-item correlations did not suggest any multicollinearity or singularity however DEFI1 was negatively or lowly correlated with all items (see Table 6.6 for items). Despite this, KMO's test for sampling adequacy (0.75) and Bartlett's test of sphericity (X^2=-444.78, p<0.001) both support factorability of the matrix. The initial two factor solution had one factor explaining 40.56% of variance and the second explaining 20.73% which was a reasonable percentage of explanation. The scree plot supported this with two factors above the elbow. The factor matrix however showed DEFI1 and DEFI2 loading on a different factor alone. This indicated that only these two items were measuring something else. Upon closer inspection of the items it appears that they are less actively defiant in their orientation than the other defiance measures and although have been taken from the previous Oliver (1991) application to this setting (Clemens & Douglas, 2005), they do appear to be inconsistent with the remaining measures. Instead of creating an additional two item variable including DEFI1 and DEFI2, it was decided to remove these items from the scale at this time. The new KMO's test of sampling adequacy (0.76) and Bartlett's test of sphericity (X^2=374.58, p<0.001) both support factorability of the new matrix and communalities and inter-item correlations all improved with no negative or low values realised. The initial eigenvalues explained 58.04% of variance and the total variance explained is now 44.23% by the single factor solution, supported visually by one point above the elbow on the scree plot.

Cronbach's alpha is good at 0.76 with high inter-item correlations and no evidence of an increase in the alpha value with any item deleted. The new variable 'Defiance' is computed through SPSS using the means of the four items that comprise it as determined above for inclusion in the final analysis (Table 6.6).

Table 6.6 - Items designed to measure defiance

Variable	Items designed to measure and items retained in actual measure (in bold)
Defiance	DEFI1: I ignore the dam management regulations and just get on with my business
	DEFI2: I ignore the dam management regulations and attempt to avoid any discussion with regulators
	DEFI3: I would sue the regulator agency for overly burdensome dam management requirements
	DEFI4: I would challenge dam management requirements in court
	DEFI5: I would challenge dam management requirements through the media
	DEFI6: I would mount a campaign with the farmers around me and the community to attack the regulatory authority about dam management laws

6.3.3.5 Dependent variable: Manipulation

Manipulation is the dependent variable that represents the highest farmer resistance to sustainable farm dam management institutional pressure. Six items were designed to capture the underlying meaning of manipulation and all were found to measure the

underlying construct and thus all six items were retained for the final analysis. The following discussion details the assumption testing of the items designed to measure manipulation, the EFA for manipulation, followed by reliability testing of the six items as one construct through Cronbach's alpha.

For the items designed to measure manipulation, the skew and kurtosis were within the normal range. The *z*-scores (between -2.44 and 2.36) suggested the absence of univariate outliers. There was limited evidence of outliers among items because communalities were all around 0.3 and above indicating the items all had a lot in common with each other. Factorability of the matrix was confirmed by KMO's test of sampling adequacy at 0.74 and a significant Bartlett's test of sphericity (X^2=348.37, p<0.001). The inter-item correlations also confirmed this with values around or over 0.3, but not at 0.8 or above which could indicate the presence of multicollinearity or singularity. The initial single factor solution had eigenvalues explaining 39.38% of the variable, supported visually by the scree plot showing one factor above the elbow. The total variance explained was 27.52%.

Cronbach's alpha was 0.69 showing good reliability of the scale and no item if deleted would improve the alpha score so all items were decided to be retained and their means computed to create the new variable 'Manipulation' for inclusion in the final analysis (Table 6.7).

Table 6.7 Items designed to measure manipulation

Variable	Items designed to measure and items retained in actual measure (in bold)
Manipulation	**MANI1: I attempt to form an alliance with the regulators regarding my dam management**
	MANI2: I attempt to include a regulator in my dam management decision making
	MANI3: I attempt to influence public perceptions on how well I manage my dam
	MANI4: I organise the farmers around me and the community to attempt to influence the dam management regulatory requirements
	MANI5: I meet with elected politicians to attempt to control the regulators on dam management issues
	MANI6: I attempt to deal with federal regulators to control the state and local government on dam management issues

6.3.3.6 Independent variable 1a - Context: Environmental Uncertainty

The first independent variable, environmental uncertainty, represents the first part to the overarching variable of 'Context'. Two items were designed to measure the variable, and only one of those was ultimately retained as measuring environmental uncertainty. The assumption testing and EFA are detailed as follows.

The skew and kurtosis for all items designed to measure Environmental Uncertainty fell within the normal range and *z*-scores between -2.84 and + 2.86 supported the absence of univariate outliers. However the communalities were very low and inter-item correlations

were realised as low as 0.06. Furthermore, KMO's test of sampling adequacy was also low at 0.50 and Bartlett's test of sphericity was not significant indicating that the matrix was not factorable (X^2=1.58, p>0.05). In light of this data, in combination with analysis of the item wordings, which do provide evidence of measuring different things, it was decided to keep only the single item CONTX-ENV1 for inclusion in the final analysis (see Table 6.8 for items). CONTX-ENV1 accurately reflects the intention of being 'uncertain' of the environment whereas CONTX-ENV2 does evoke the assumption that the participant is going further to take some action because of the uncertainty, not just that the uncertainty exists which is the intention of the measure (see Chapter 4, Section 4.4.1). The risks of single-item measures are highlighted in the literature. Peter (1979) and others identify that multiple-item measures are inherently more 'reliable' because they enable computation of correlations between items. These correlations, if positive, produce a high average correlation (that is, a high coefficient alpha) suggesting that the researcher is more accurately representing a construct (Bergkvist & Rossiter, 2007). However, it is common for practitioners to use single item scales and it has also been supported in the literature to be appropriate practice (Rossiter, 2002). Not only do single-item measures minimize respondent refusal by reducing questionnaire length and repetition, but if the object of the construct is close to 'singular', meaning that it can be easily and uniformly imagined (Rossiter, 2002), then single item constructs are valid.

Table 6.8 - Items designed to measure environmental uncertainty

Variable	Element	Items designed to measure and items retained in actual measure (in bold)
Context	Environmental uncertainty	**CONTX-ENV1: I am worried about the future of water availability to continue my farming operations**
		CONTX-ENV2: I block my spillway because of the uncertainty of future runoff in my region

6.3.3.7 Independent variable 1b – Context: Interconnectedness

Interconnectedness is the independent variable that represents the other part of the overarching variable 'Context'. Three items were designed to capture the underlying meaning of interconnectedness and two of them were found to measure the underlying construct and thus were retained for inclusion in the multiple regression analyses. The following discussion details the assumption testing of the items for the EFA and then the EFA for interconnectedness, followed by reliability testing of the two items as one construct through Cronbach's alpha.

The skew and kurtosis for all items designed to measure interconnectedness fell within a normal range. However, z-scores between -2.58 and +4.43 do suggest the possibility of an

outlier which was localised at CONTX-INTER2. It was decided to proceed and communalities were satisfactory except for CONTX-INTER2 (0.04) (see Table 6.9 for items). KMO's test of sampling adequacy was low but adequate for the low number of items (0.56) and Bartlett's test of sphericity was significant (X^2=52.38, p<0.001) suggesting factorability of the matrix. The single factor solution explained 23.43% of the variance however CONTX-INTER2 did not load in the factor matrix. To further test the decision to possibly remove CONTX-INTER2 from the scale, Cronbach's alpha was run which showed a low value of 0.40. This would improve to 0.46 with removal of CONTX-INTER2 so this item was removed. The subsequent initial single item solution (with retained adequate assumptions of linearity, normality and factorability of the matrix), explained 64.92% with a total variance explained of 29.76%. The new variable 'Interconnectedness' was computed through the means of the two items that comprised it.

Table 6.9 Items designed to measure interconnectedness

Variable	Element	Items designed to measure and items retained in actual measure (in bold)
Context	Interconnectedness	**CONTX-INTER1: Most of the farmers in my region manage their dams in the same way**
		CONTX-INTER2: I have worked with other farmers on dam management issues
		CONTX-INTER3: The farmers around me share the water fairly

6.3.3.8 Independent variable 2a – Control: Legal Coercion

Legal coercion is the independent variable that represents the first part of the overarching variable 'Control'. Ten items were designed to capture the underlying meaning of legal coercion. The EFA found that except for two items which needed to be removed, there were actually two underlying variables being measured – one with three items and another distinct variable with five items. The following discussion details the assumption testing of the items for the EFA and then the EFA for legal coercion, followed by reliability testing of the three items designed to measure 'Legal Coercion – Threat' and the five items measuring 'Legal Coercion – Action'.

For all items designed to measure legal coercion, skew and kurtosis values fell within the normal range and z-scores did not show evidence of univariate outliers (between -3.53 and +2.34). Communalities were low for CONTR-LEG1 (0.09) and CONTR-LEG5 (0.06) but all others were acceptable so it was decided to proceed (see Table 6.10 for items). Inter-item correlations highlighted anomalous relationships with CONTR-LEG3, CONTR-LEG6 and CONTR-LEG8-10 all with low or negative inter-item correlations with other items. There was no evidence of multicollinearity or singularity. However, factorability of the matrix was

assumed with KMO's test of sampling adequacy a good value (0.67) and Bartlett's test of sphericity significant (X^2=455.36, p<0.001).

The initial four factor solution showed factor one explaining 23.07% of the variance, and the second factor 15.48% of the variance, and the third and fourth factors 10.91% and 10.46% respectively. The scree plot was undulating with no distinct elbow. The factor and pattern matrix support the deletion of CONTR-LEG1 and CONTR-LEG5 which did not load. However, the remaining items distinctly load on two different variables. Upon revisiting of the wording of the actual items, it is decided to create two new variables. One that relates to the perceived *threat* of legal coercion and the other that relates to actual legally coercive *action* that is perceived to be in place.

The new proposed variable 'Legal Coercion – Threat' comprised items CONTR-LEG2, CONTR-LEG4 and CONTR-LEG7 had adequate inter-item correlations but no evidence of any too high giving rises to multicollinearity or singularity. KMO's test of sampling adequacy (0.63) and Bartlett's test of sphericity (X^2=107.37, p<0.001) supported factorability of the matrix, especially when combined with the resulting good communalities existing between items over 0.3. The initial eigenvalues explained 54.10% and the total variance explained was 31.71%. Cronbach's alpha was 0.57 suggesting adequate reliability of the new scale and no items when deleted would improve the alpha value. Thus the new variable of 'Legal Coercion – Threat' was computed using the means of the items used to measure it.

The second new proposed variable 'Legal Coercion – Action' comprised items CONTR-LEG3, CONTR-LEG6, CONTR-LEG8, CONTR-LEG9 and CONTR-LEG10. The inter-item correlations were adequate around 0.3 and communalities also indicated that each item had a lot in common with each other. KMO's test of sampling adequacy (0.71) and Bartlett's test of sphericity (X^2=262.76, p<0.001) supported factorability of the matrix. The initial eigenvalues explained 42.46% of the variance, supported visually by the scree plot with 1 factor loading above the elbow. The total variance explained was 28.48%. Cronbach's alpha was adequate at 0.65 suggesting a reliable scale that would not improve with deletion of any item. All the items were retained for computation of means to create the new variable 'Legal Coercion – Action' for use in the final analysis (Table 6.10).

The creation of the additional legal coercion variable as a result of the exploratory factor analysis, indicate an increase from 16 testable hypotheses to 17. The new variables, legal coercion – threat (IV2a(i)), and legal coercion – action (IV2a(ii)) are tested by hypotheses '2a(i)' and '2a(ii)' and will be discussed in the following chapter.

Table 6.10 - Items designed to measure legal coercion action and threat

Variable	Element	Items designed to measure and items retained in actual measure (in bold, 'Threat' variable also italicised)
Control	Legal Coercion	CONTR-LEG1: I have received a notice from the regulator to change my dam management practice
		CONTR-LEG2: I am fearful of enforcement of dam management laws by regulators (THREAT)
		CONTR-LEG3: The regional field officer periodically checks my dams (ACTION)
		CONTR-LEG4: I feel pressure from government about my dam management behaviour (THREAT)
		CONTR-LEG5: I am dependent on government for dam management information and education
		CONTR-LEG6: The authority periodically checks my water meter (ACTION)
		CONTR-LEG7: The laws require me to provide too much water for the environment (THREAT)
		CONTR-LEG8: The maximum storage capacity of my dam is checked periodically (ACTION)
		CONTR-LEG9: Regulations require me to have an Emergency Action Plan for my dam as part of my dam management (ACTION)
		CONTR-LEG10: Regulations require me to periodically report on the safety of my dam as part of my dam management (ACTION)

6.3.3.9 Independent variable 2b – Control: Voluntary Diffusion

The independent variable voluntary diffusion, represents the second part to the overarching variable of 'Control'. Three items were designed to measure the variable of voluntary diffusion, and all three were able to be retained. The assumption testing and EFA, in addition to reliability testing of the three items as one construct, are detailed as follows.

Skew and kurtosis values fell within the normal range for the items designed to measure Voluntary Diffusion. The *z*-scores suggested the absence of univariate outliers (-2.40 to +2.04) and communalities were all around 0.3 suggesting that outliers among items were at a minimum. KMO's test of sampling adequacy was acceptable at 0.57 and Bartlett's test of sphericity is significant at (X^2=30.73, p<0.001) which supported factorability of the matrix. The initial eigenvalues explained 44.21% of the variance and the total variance explained was a low 16.96%. However the scree plot did indicate that one factor was strongly loading above the elbow. It was decided to test Cronbach's alpha to determine the reliability of the scale that was only marginally valid at this stage. Cronbach's was low at 0.40 and no items deleted would improve it. The researcher reflected on the wording of the items and attempted testing with CONTR-VOL3 removed and whilst the total variance explained improved to 17.96%, the Cronbach's alpha reduced to 0.30, worsening the reliability of the scale (see Table 6.11 for items). All items were decided to be retained in this measure of moderate validity and reliability and computed as means into the new variable 'Voluntary Diffusion'. However, this variable is flagged for concern if anything anomalous arises in the final analysis.

Table 6.11 - Items designed to measure voluntary diffusion

Variable	Element	Items designed to measure and items retained in actual measure (in bold)
Control	Voluntary diffusion	**CONTR-VOL1: My neighbours and I manage our dams in a way that limits the impact of our farming operations, not because of any regulations**
		CONTR-VOL2: There is no need for so much regulation as farmers around me do the right thing anyway
		CONTR-VOL3: I think the spillways of my dam are safe

6.3.3.10 Independent variable 3a – Content: Lack of Decision Making Power

Lack of decision making power is the independent variable that represents the first part of the overarching variable of 'Content'. Two items were designed to capture the underlying meaning of lack of decision making power and both items were found to measure the underlying construct and thus were retained for inclusion in the multiple regression analyses. The following discussion details the assumption testing of the items for the EFA and then the EFA for lack of decision making power, followed by reliability testing of the two items as one construct through Cronbach's alpha.

For the variable lack of decision making power, the values for skew and kurtosis fell within the normal range and z-scores, although one value for CONT-DEC1 was high (creating a *z*-score range of -4.02 to +1.57) the item was retained. Communalities were moderately low however correlations were positive and strong, though none at 0.8 or above possibly suggesting multicollinearity or singularity. KMO's test of sampling adequacy was moderate at 0.50 and Bartlett's test of sphericity significant (X^2=18.59, p<0.001) indicating that although these scores were low, factorability of the matrix was possible. Initial eigenvalues explained 60.64% of the variance and total variance explained was 21.12%. Cronbach's alpha was 0.40 indicating low reliability of this scale however upon further consideration of the item wordings, it was decided to retain both items as they captured dimensions of lack of decision making power important to the research. Both items were averaged for inclusion in the computation of the variable 'Decision Making Power', however this variable was flagged for consideration as a single item measure should any anomalous results emerge in the final analysis (see Table 6.12).

Table 6.12 - Items designed to measure lack of decision making power

Variable	Element	Items designed to measure and items retained in actual measure (in bold)
Content	Lack of decision making power	**CONT-DEC1: The dam management regulations restrict me from storing water for my usual farming operations**
		CONT-DEC2: I am limited by the laws that tell me how I must store my water in my dam

6.3.3.11 Independent variable 3b – Content: Inconsistency with Organisational Goals

The item designed to measure inconsistency with organisational goals was a single item measure. Although this has been considered to be undesirable in the literature in the past (Nunnally, 1978; Churchill, 1979) there is emerging recognition that single-item measures of constructs are as valid as multiple-item measures (Rossiter, 2002). In addition, wording of the pure intention of the variable in a novel area of research (Bergkvist & Rossiter, 2007) captures adequately the intention of all dimensions of 'Consistency with Organisational Goals' (see Table 6.13).

Table 6.13 - Items designed to measure inconsistency with organisational goals

Variable	Element	Items designed to measure and items retained in actual measure (in bold)
	Consistency of organisational goals	**CONTE-CONS: The dam management regulations are not in line with the goals of this farm**

6.3.3.12 Independent variable 4: Constituents - All

The elements that make up the overarching variable of Constituents (Multiplicity (4a), Dependence (4b), Industry Groups (4 Sub1), Insurers (4 Sub2), Banks (4 Sub3), Community Groups (4 Sub4), Environmental Groups (4 Sub5), Media (4 Sub6)) are single item measures as all relate to specific issues that relate to constituents or actual specific constituents themselves. All items have skew and kurtosis within the normal range except for item CONST-SUB5 which reaches a kurtosis value of 8.23, slightly above the critical value of 7 (see Table 6.14 for items). This item/variable is flagged for concern in the final analysis should any anomalous results arise. The *z*-scores are within an acceptable range for all of these items/variables suggesting that univariate outliers are not a problem. The next set of variables are designed as single item variables.

Table 6.14 - Items designed to measure single measure constituent variables listed

Variable	Element	Items designed to measure and items retained in actual measure (in bold)
Constituents	Multiplicity	**CONST-MULT: There are too many organisations putting pressure on me about my farm dam**
	Dependence	**CONST-DEP: I am dependent on government funding so that is why I comply with what the regulators want for my farm dam**
	Industry groups	**CONST-SUB1: My farming industry association guides me on the best way to manage my dam**
	Insurers	**CONST-SUB2a: My insurance policy has a clause related to farm dams**
	Banks	**CONST-SUB2b: My bank requires info about my farm dam**
	Community groups	**CONST-SUB3: I attend local community meetings that discuss farm dam issues**
	Environmental groups	**CONST-SUB4: I discuss with local environmental groups, the best way to manage my dam**
	Media	**CONST-SUB5: I have changed my dam management practice because of an article in the media**

6.3.3.13 Independent variable 5a – Cause: Social Fitness

The social fitness independent variable represents the first part to the overarching variable of 'Cause'. Two items were designed to measure this variable, and only one of those was ultimately retained as measuring social fitness. The assumption testing and EFA are detailed as follows.

For the two items designed to measure social fitness, the skew and kurtosis values are within the normal range and the *z*-scores do not detect the presence of univariate outliers (between -2.75 and +2.73). However, correlations between the two items were negative (-0.14) which is supported by the low communalities between the items (0.02 for both). In addition KMO's test of sampling adequacy is only 0.50 and Bartlett's test of sphericity only marginally significant (X^2=7.91, p<0.005). The initial eigenvalues explain 59.98% of the variance however the total variance explained by the two items is only 13.87% indicating that something else is explaining the measure. The negative Cronbach's alpha (-0.32) confirms a negative covariance among items. It is decided upon closer inspection of the wording of the items that only CAUS-SOC1 should be retained as it captures the elements of social interactions and dependence on these whereas CAUS-SOC2 is measuring something else, perhaps better related to external confirmations of poor management which will not be included in the final analysis at this time (Table 6.15).

Table 6.15 - Items designed to measure social fitness

Variable	Element	Items designed to measure and items retained in actual measure (in bold)
Cause	Social fitness	**CAUS-SOC1: I comply with dam management regulations so I do not upset the farmers downstream**
		CAUS-SOC2: I have had complaints about my dam management from neighbours

6.3.3.14 Independent variable 5b – Cause: Economic Fitness

The independent variable economic fitness represents the second part to the overarching variable of 'Cause'. Two items were designed to measure the variable of economic fitness and both were able to be retained. The assumption testing and EFA, in addition to reliability testing of the two items as one construct, are detailed as follows.

Skew and kurtosis values for the items designed to measure economic fitness all fell within the normal range and the *z*-scores also reflect the absence of univariate outliers (ranging from -1.65 to +2.20). The communalities among items were highly satisfactory around 0.30 and the inter-item correlations were around 0.60 but none were close to 0.8 or 1 which can indicate multicollinearity or singularity respectively. KMO's test of sampling adequacy was low 0.50 but Bartlett's test of sphericity was significant (X^2=130.84, p<0.001) indicating that

it was acceptable to proceed as the matrix was moderately factorable. The initial eigenvalues explained 76.37% of the variance, supported visually on the scree plot showing one factor loading strongly above the elbow. The total variance explained is 52.64% which was a strong result. Cronbach's alpha was 0.70 suggesting a highly reliable scale with deletion of no items supporting an increase in alpha value. The scores for the items were averaged to compute the new variable 'Economic Fitness' for inclusion in the final analysis (Table 6.16).

Table 6.16 - Items designed to measure economic fitness

Variable	Element	Items designed to measure and items retained in actual measure (in bold)
Cause	Economic fitness	**CAUS-ECO1: My annual budget includes an amount that allows me to check and ensure my spillway satisfies current safety standards**
		CAUS-ECO2: My annual budget includes an amount that allows me to maintain the safety of my dam as part of my dam management

6.4 Multiple regression

Multiple regression analysis was undertaken to test hypotheses 1 to 5 that were presented in Chapter 4 (Section 4.4). Various relationships emerged as a result of the multiple regression analyses. All dependent variables were significantly predicted by the multiple regression models, however individual predictors each accounted for varying levels and directions of prediction.

In addition, moderated multiple regressions were undertaken to test the effect of the institutional environment hypotheses 1 to 5 (results of each hypotheses test are summarised in Chapter 7). None of the moderated multiple regression models supported the overall presence of institutional environment as a moderating variable in the model. However, there were individual interaction effects present which will be discussed and are highlighted as each model is presented. A state-by-state multiple regression analysis was then undertaken for each dependent variable in order to cross-check results attained in full sample multiple regression and moderated multiple regression analyses and also provide further information for state-based comparison.

Firstly, the assumptions of multiple regression detailed in Chapter 5 (Section 5.5.3.1) are addressed in Table 6.17. Results that support the assumption testing are available in Appendices 3, 5, 6 and 7 as detailed within the table.

Table 6.17 - Assumption checking: Multiple regression

	Assumption	Detail
1	Ratio of cases to independent variables – sample size	Highest of either (1) *n*>50 +8m *OR* (2) *n*>104+m (Tabachnick & Fidell, 2001). In this case m=17 so, (1) = 186 *OR* (2) 121 This study has sample size of 404 which is highly satisfactory. For the state-based analysis the sample size is reduced to 100/102 which is lower than the Tabachnick & Fidell guidelines however there is literature in support of samples 100 and over as being suitable for multiple regression (Coakes *et al*., 2009)
2	Normality of dependent and independent variables	Met for EFA, see Table 6.2.
3	Linearity	Met for EFA, see Table 6.2.
4	Outliers on dependent variable and among independent variables	As indicated in the assumptions for EFA, all variable's *z*-scores were close to or within the normal range (Appendix 4). Mahalanobis distance was examined for multivariate outliers. The critical Chi-square value of $X^2(18) = 42.31$, $p<0.001$ was considered the cut-off for Mahalanobis distance values (Tabachnick & Fidell, 2001). However, from this comparison, there were multivariate outliers in the models with Mahalanobis Distance values occurring over 42.31 (see Appendix 6). However, the final decision about retaining or discarding outlier cases is not merely a technical one based on some critical value of Mahalanobis distance. Of course, if outlier cases are that of different population than the rest of the cases, then outliers should be removed from the sample. However, if they appear to be simply cases with unusual scores within the same population, then they should be retained to maintain validity in the research, especially in an exploratory and novel area such as farm dam management. It has even been suggested that multivariate outliers do represent a segment of the population and should be retained to ensure generalisability to the entire population as when they are deleted, 'the analyst is running risk of improving the multivariate analysis but limiting its generalisability' (Hair *et al.* 1998, p.66). However, there were seven cases with values over 100 (Appendix 6) thus it was decided to run the multiple regression without these cases (*n*=397) to view changes in critical b-values. Ultimately, there was not enough difference in the R^2, F and b-values to warrant removal of these seven cases, which added to generalisability of the findings to moderate (two from New South Wales) and very strong and well-integrated, institutional environments (five from Tasmania).
5	Multicollinearity and singularity	Discussed at each hypothesis test below. Correlation matrix presented in Appendix 7.
6	Normality, Linearity, and Homoscedasticity of Residuals	Checked visually on histograms, Normal P-P Graphs and Scatterplots presented for each regression in Appendix 8.

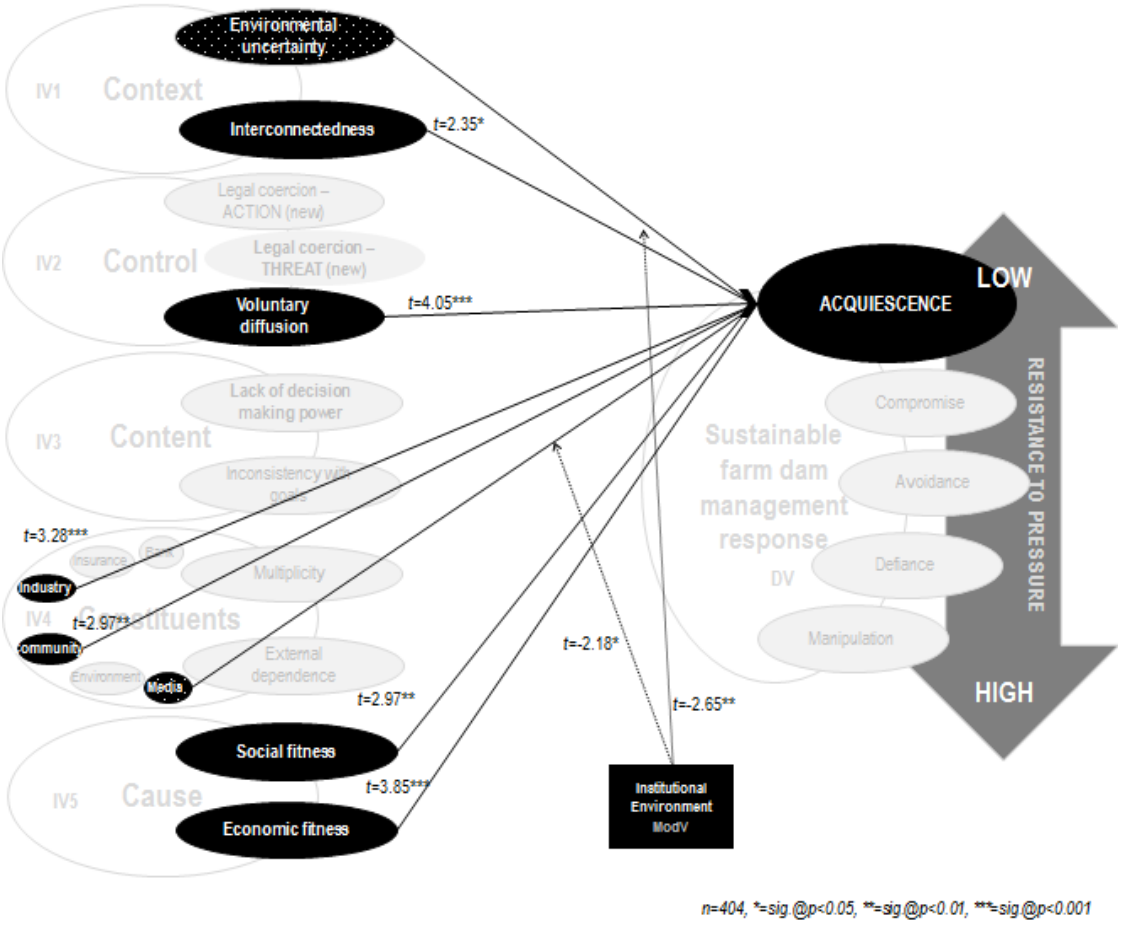
As a result of the assumption checking in Table 6.17, it was suitable to proceed with the analysis. The multiple regression, moderated multiple regression, and state-based multiple regression for each institutional antecedent's relationship to each level of the dependent variable will be presented in order from low resistance (DV1, Acquiescence) to high resistance (DV5, Manipulation) to sustainable farm dam management institutional pressure.

6.4.1 Sustainable farm dam management response: Acquiescence

Acquiescence, representing low farmer resistance to sustainable farm dam management pressure, was the most predicted dependent variable with eight significant relationships with the independent variables in the multiple regression, two of which the effects were moderated by the strength of the institutional environment. Figure 6.5 highlights the relationship of the independent and moderating variables to an acquiescent response to farm dam management pressure, based on the conceptual model of hypothesised

relationships developed in Chapter 4, Figure 4.1 with significant relationships from the multiple regression of the full sample highlighted.

Figure 6.5 - Statistical relationships of independent variables to dependent variable - Acquiescence



The following three sections present the results of the multiple regression model, the model moderated by institutional environment, and the state-based multiple regression for the dependent variable acquiescence.

6.4.1.1 Multiple regression analysis – Acquiescence

Table 6.18 shows the results of testing the sustainable farm dam management institutional pressures that predict an acquiescent, or passive, resistance of farmers. The overall model was significant and the independent variables predicted 37.90% of the variability in a passive, or acquiescent response to institutional pressure ($F(18, 385) = 13.08$, $p<0.001$). Voluntary diffusion of a practice throughout a region or industry was the strongest predictor of an acquiescent response to sustainable farm dam management pressures ($\beta=0.20$, $t(403)=4.05$, $p<0.001$), followed by economic fitness ($\beta=0.19$, $t(403)=3.85$, $p<0.001$). Industry body pressure also strongly significantly explained a passive response ($\beta=0.15$, $t(403)=3.28$, $p<0.001$) followed by community group pressure ($\beta=0.14$, $t(403)=2.97$,

p<0.01). Perceived social fitness in the institutional field (β=0.13, t(403)=2.97, p<0.01) and also interconnectedness with other constituents in the field was a predictor (β=0.11, t(403)=2.35, p<0.05).

Table 6.18 - Multiple regression analysis – Acquiescence

Variable	R^2 (%)	F	t	b	$SE\ b$	β
(Constant)	37.90	13.08***	0.38	0.16	0.42	
Environmental uncertainty (IV1a)			0.12	0.00	0.02	0.01
Inter-connectedness (IV1b)			2.35**	0.11	0.05	0.11
Legal coercion-action (IV2a(i) new)			0.90	0.05	0.05	0.05
Legal coercion-threat (IV2a(ii) new)			0.29	0.01	0.05	0.02
Voluntary diffusion (IV2b)			4.05***	0.23	0.06	0.20
Lack of decision making power (IV3a)			1.94	0.05	0.02	0.09
Inconsistency with goals (IV3b)			-1.26	-0.04	0.03	-0.06
Multiplicity (IV4a)			0.32	0.01	0.03	0.02
Dependence on constituent (IV4b)			0.46	0.02	0.04	0.02
Industry body pressures (IV4 Sub1)			3.28***	0.10	0.03	0.15
Insurer pressures (IV4 Sub2)			-0.41	-0.01	0.04	-0.01
Bank pressures (IV4 Sub3)			0.52	0.02	0.04	0.02
Community group pressures (IV4 Sub4)			2.97**	0.09	0.03	0.14
Environmental group pressures (IV4 Sub5)			1.56	0.05	0.03	0.07
Media pressures (IV4 Sub 6)			-0.77	-0.04	0.05	-0.03
Social fitness (IV5a)			2.97**	0.10	0.03	0.13
Economic fitness (IV5b)			3.85***	0.14	0.04	0.19
Institutional Environment (ModV)			1.15	0.03	0.03	0.05

*n=404, *=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001*

6.4.1.2 Moderated multiple regression analysis - Acquiescence

The institutional environment or state where the participant owns or manages a farm dam is predicted to have a moderating effect on the relationship between the IVs and the DVs. The relationship between the variables is expected to vary at different levels of geographic location (that is, institutional environment). Because the strength and integration of the institutional environment is measured linearly by this research, that is on four equidistant points of 1=weak and poorly integrated (South Australia) and 4=strong and best practice integration (Tasmania), it can be assumed that the effect of institutional environment on the IV and DV relationship is linear and the relationship increases or decreases as the moderator increases or decreases.

For the moderated multiple regression, the initial step was to create standardised variables for all of the independent variables that would possibly be moderated by the interaction variable, and for the interaction/moderator variable itself. This required the creation of *z*-scores so that zero was meaningful for all IVs and the ModV so when combined together as one variable comprising the 'interaction term', their errors did not accumulate and they could be considered on the same scale (Irwin & McClelland, 2001). The first group of the first dependent variable, all of the independent variables and the moderator variable were added into Block 1, the multiple regression un-moderated by location (for example, Table 6.18 for Acquiescence). Then all of the interaction terms were added into a second block,

'Block 2', or the moderated model for the same dependent variable. The hierarchical multiple regression approach allows for comparison of improvement in the mode (R^2 change) to determine whether the interaction variable does in fact moderate the relationship between the independent variable(s) and the dependent variable. This was undertaken after initial full multiple regression testing (Block 1, or the un-moderated model) for all five dependent variable models. If a significant interaction coefficient was realised, the data were then plotted in Excel where the slope was analysed for the variables of interest. The simple slopes of +1 or -1 standard deviation of the moderator variable were plotted with two regression analyses substituting the independent variable of interest 'low' and 'high' and moderating variable 'low' and 'high' (Aiken & West, 1991).

For the first model under investigation of how the institutional environment affects the relationship between the independent variables and an acquiescent response, the results of a moderated multiple regression are presented in the moderated model for acquiescence (Table 6.19). With the inclusion of the interaction term there was no change in the predictive value of the model ($F(17,368)=1.38$, $p>0.05$). In fact, the inclusion of the interaction terms reduced the *F*-value for the model, although it remained highly significant ($F(17,368)=7.51$, $p<0.001$). These results suggest that the overall relationship between institutional pressures and a passive, or acquiescent, sustainable farm dam management response to these pressures is not moderated by the strength or integration of the institutional environment. However, there are individual interactions that are significant when considered independently of the overall model. Table 5.19 shows that environmental uncertainty is negatively moderated by the institutional environment ($\beta=-0.13$, $t(403)=-2.65$, $p<0.01$). That is, the amount of an acquiescent response to sustainable farm dam management pressure that is predicted by environmental uncertainty is varied by the strength and integration of the institutional environment.

Table 6.19 - Moderated multiple regression analysis – Acquiescence

Variable	R^2 (%)	$R^2\Delta$	F	t	b	$SE\ b$	β
(Constant)	41.70	3.70	7.51***	0.45	0.19	0.42	
Environmental uncertainty* Institutional Environment				-2.65**	-0.09	0.03	-0.13
Inter-connectedness* Institutional Environment				-0.77	-0.03	0.03	-0.03
Legal coercion-action * Institutional Environment				1.19	0.04	0.04	0.06
Legal coercion- threat * Institutional Environment				1.18	0.03	0.03	0.05
Voluntary diffusion* Institutional Environment				-0.47	-0.02	0.04	-0.02
Lack of decision making power* Institutional Environment				0.48	0.02	0.04	0.02
Inconsistency with goals* Institutional Environment				-0.17	-0.01	0.03	-0.01
Multiplicity* Institutional Environment				-0.62	-0.02	0.03	-0.03
Dependence on constituent* Institutional Environment				0.95	0.03	0.03	-0.04
Industry body pressures* Institutional Environment				0.22	0.01	0.03	0.01
Insurer pressures* Institutional Environment				-0.52	-0.02	0.03	-0.02
Bank pressures* Institutional Environment				1.47	0.05	0.03	0.07
Community group pressures* Institutional Environment				1.64	0.05	0.03	0.08
Environmental group pressures* Institutional Environment				-0.64	-0.02	0.03	-0.03
Media pressures* Institutional Environment				-2.18*	-0.07	0.03	-0.10
Social fitness* Institutional Environment				0.36	0.01	0.03	0.01
Economic fitness* Institutional Environment				-1.22	-0.04	0.03	-0.06

*n=404, *=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001*

To illustrate this interaction effect, the interaction was decomposed using simple slopes analysis and the regression lines at three levels of the moderator (-1 SD, Mean, +1 SD of institutional environment) were plotted as recommended by Aiken and West (1991). Figure 6.6 shows the result of a regression equation that is a calculation of the relationship of high IV and high ModV; high IV and low ModV; low IV and high ModV; and Low IV and low ModV which can then be graphed to see the interaction effect. This way it is possible to see where the interaction is occurring. At low levels in environmental uncertainty, there was little relationship between levels of strength of institutional environment and acquiescence, whereas at high levels of environmental uncertainty, strength of the institutional environment was responsible for the variation in acquiescence to institutional pressure.

Figure 6.6 - Moderation of the effect of environmental uncertainty on an acquiescent response to sustainable farm dam management pressure by the institutional environment

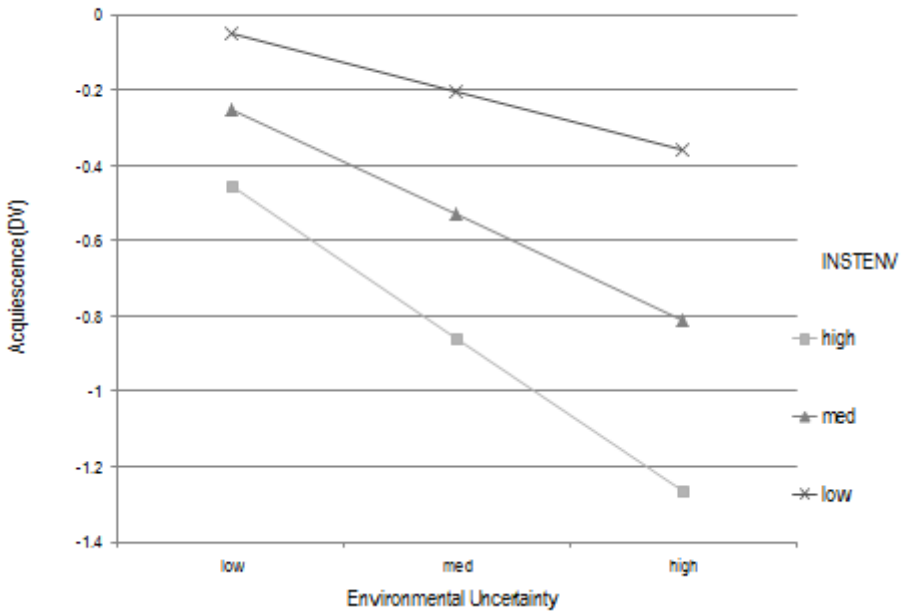
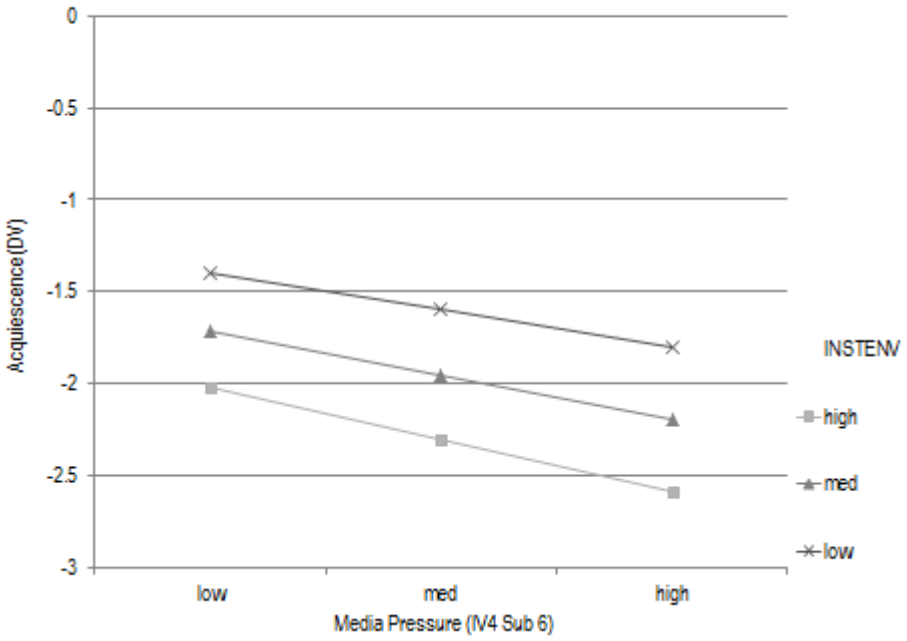


Figure 6.6 suggests that for those who manage their dam in a very strong, well-integrated institutional environment, high perceptions of environmental uncertainty are associated with less acquiescence to sustainable farm dam management pressure. That is, the more uncertainty there exists in those environments, the more likely farmers will be resistant to pressure.

Also presenting a significant interaction term is the response to media pressures (β=-0.10, t(403)=-2.18, p<0.01). Figure 6.7 plots the regression equation for the four values of the DV as per previously but now for media pressure.

Figure 6.7 - Moderation of the effect of media pressure on an acquiescent response to sustainable farm dam management pressure by the institutional environment



The relationship of the interaction term plotted in Figure 6.7 suggests that for farmers managing their farm dams in strong and well integrated institutional environments, farm dam sustainability pressure from the media is negatively associated with a passive, acquiescent response to pressure to manage dams sustainably. At low levels of media pressure, there was little relationship between levels of strength of institutional environment and acquiescence, whereas at high levels of media pressure, strength of the institutional environment was responsible for the variation in acquiescence to institutional pressure.

The following section discusses this, and the other relationships discovered through presentation of a state-based multiple regression analysis.

6.4.1.3 State-based multiple regression analysis – Acquiescence

The total sample (n=404) was separated into state-by-state sets for analysis in individual multiple regressions in order to further investigate the relationships emerging. The resulting state-based models (Table 6.20) were all significant predictors of the dependent variable acquiescence. The model for South Australia predicted 42.60% of variability in acquiescence (F(17,82)=3.58, p<0.001), New South Wales 58.80% (F(17,82)=7.06, p<0.001), Victoria 51.20% (F(17,82)=5.19, p<0.001), and the Tasmanian model predicted 45.60% of variability in the dependent variable (F(17,82)=4.04, p<0.001.

Table 6.20 – State-based multiple regression analysis – Acquiescence

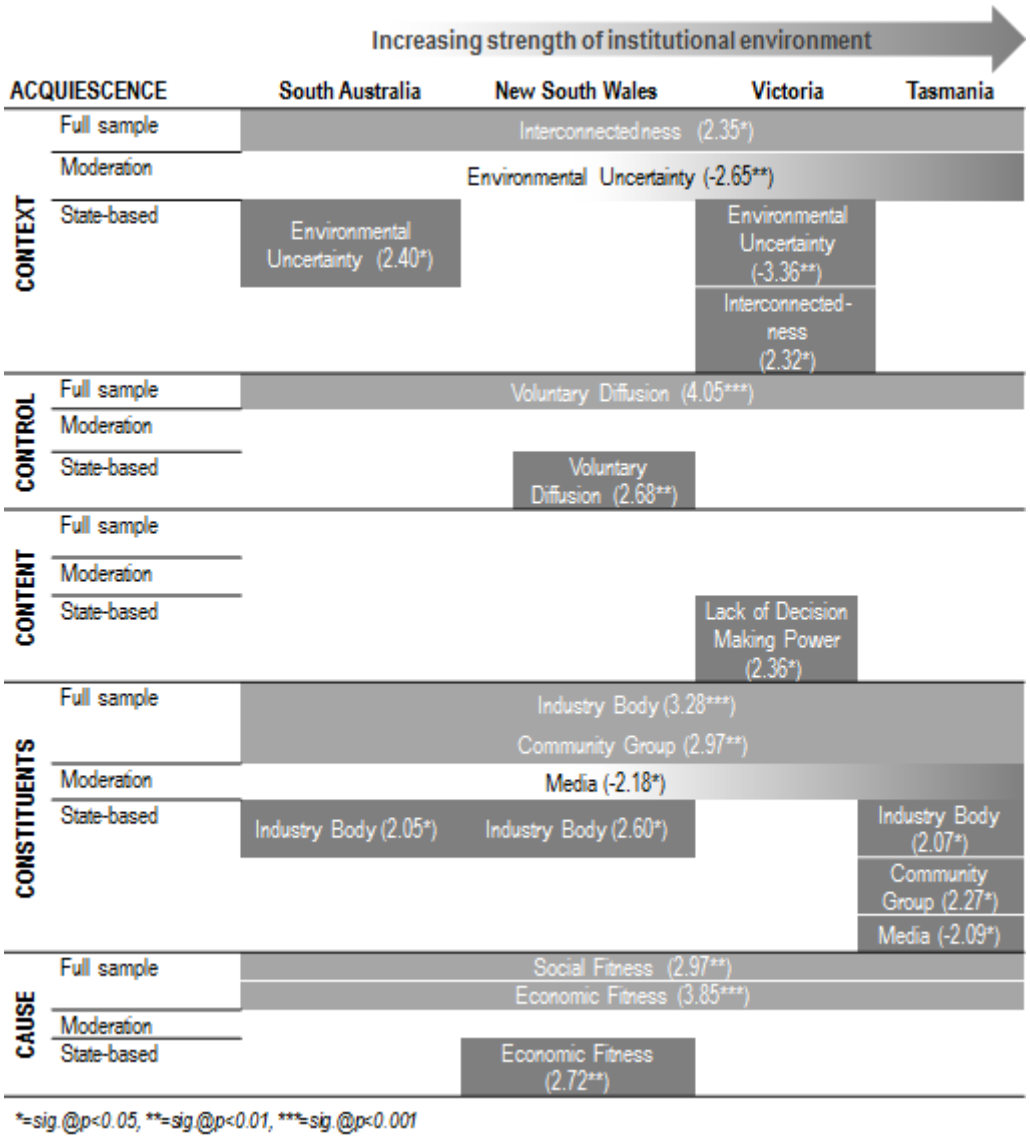
Test State	South Australia (*n*=100)						New South Wales (*n*=102)						Victoria (*n*=102)						Tasmania (*n*=100)					
Variable	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*
(Constant)	42.60	3.58***	0.16	0.170	1.05		58.80	7.06***	-0.23	-0.17	0.73		51.20	5.19***	-0.36	-0.29	0.81		45.60	4.04***	1.06	1.13	1.07	
Environmental uncertainty (IV1a)			2.40*	0.13	0.06	0.27			1.61	0.07	0.04	0.13			-3.36***	-0.18	0.05	-0.37			0.42	0.02	0.06	0.04
Inter-connectedness (IV1b)			1.51	0.17	1.05	0.15			1.40	0.12	0.08	0.12			2.32*	0.20	0.09	0.23			-0.50	-0.06	0.13	-0.05
Legal coercion-action (IV2a(i) new)			-0.78	-0.10	0.06	-0.08			1.87	0.23	0.12	0.20			0.36	0.03	0.09	0.04			1.32	0.17	0.13	0.14
Legal coercion-threat (IV2a(ii) new)			-1.16	-0.11	0.11	-0.16			-0.91	-0.08	0.09	-0.09			1.38	0.12	0.09	0.16			1.03	0.12	0.12	0.12
Voluntary diffusion (IV2b)			1.81	0.27	0.12	0.22			2.64**	0.28	0.11	0.25			1.57	0.16	0.10	0.17			1.21	0.15	0.12	0.13
Lack of decision making power (IV3a)			-0.79	-0.08	0.10	-0.09			2.49*	0.17	0.07	0.21			1.56	0.19	0.07	0.23			-0.05	-0.01	0.10	-0.01
Inconsistency with goals (IV3b)			-0.37	-0.03	0.07	-0.04			-1.43	-0.08	0.06	-0.11			-1.61	-0.10	0.06	-0.15			-0.16	-0.01	0.08	-0.02
Multiplicity (IV4a)			0.59	0.03	0.06	0.07			1.56	0.08	0.06	0.14			0.20	0.01	0.05	0.02			-0.57	-0.04	0.07	-0.06
Dependence on constituent (IV4b)			-0.12	-0.01	0.08	-0.01			1.70	0.13	0.07	0.14			-0.18	-0.01	0.07	-0.02			1.07	0.11	0.10	0.11
Industry pressures (IV4 Sub1)			1.87	0.11	0.06	0.18			2.60*	0.15	0.06	0.24			1.44	0.09	0.06	0.13			2.07*	0.16	0.08	0.21
Insurer pressures (IV4 Sub2)			2.05*	0.18	0.09	0.20			1.57	0.87	0.05	0.14			0.71	0.05	0.07	0.07			1.00	0.08	0.08	0.10
Bank pressures (IV4 Sub3)			-0.80	-0.09	0.11	-0.07			-1.33	-0.13	0.10	-0.14			-0.28	-0.03	0.09	-0.03			0.80	0.06	0.07	0.08
Community group pressures (IV4 Sub4)			0.97	0.06	0.06	0.09			-0.46	-0.03	0.06	-0.04			1.20	0.11	0.06	0.18			2.27*	0.15	0.07	0.22
Environmental group pressures (IV4 Sub5)			0.51	0.03	0.06	0.05			1.56	0.11	0.07	0.14			1.80	0.10	0.05	0.15			-0.43	-0.03	0.07	-0.04
Media pressures (IV4 Sub 6)			1.47	0.16	0.11	0.14			-0.40	-0.05	0.12	-0.04			0.39	0.03	0.08	0.03			-2.09*	-0.36	0.17	-0.20
Social fitness (IV5a)			1.53	0.11	0.07	0.15			0.33	0.00	0.06	0.00			1.36	0.10	0.07	0.13			1.76	0.14	0.08	0.18
Economic fitness (IV5b)			1.80	0.13	0.07	0.18			2.72**	0.18	0.07	0.26			1.94	0.14	0.07	0.20			0.67	0.06	0.08	0.07

=sig.@p<0.05, **=sig.@p<0.01, *=sig.@p<0.001*

In the main, the results of the state-based multiple regression analysis support those discovered in the multiple regression and moderated multiple regression of the full sample. As per the moderated relationships found in the previous section (Section 6.4.1.2), in a stronger sustainable farm dam management institutional environment (in the case of the state-based investigation, specifically Victoria), environmental uncertainty negatively predicts acquiescence (β=-0.37, t(102)=-3.36, p<0.001). That is, when the environment for managing farm dams is not perceived to be uncertain in Victoria, then farmer resistance to pressure to manage dams sustainably will be low. This relationship is evidenced further in South Australia (weak institutional environment) where high environmental uncertainty will predict low resistance to sustainable farm dam management pressures (β=0.27, t(100)=2.40, p<0.05). Similarly for media pressure, the other moderated relationship discovered in Section 6.4.1.2, a strong negative predictive relationship is found between media pressure and acquiescence in the strong farm dam institutional environment of Tasmania (β=-0.20, t(100)=-2.09, p<0.05), with no effect in the other states.

However, relationships did emerge that were not found in the multiple regression of the full sample: In South Australia (weak institutional environment), sustainable farm dam insurance pressure is a predictor of an acquiescent response (β=0.20, t(100)=2.05, p<0.05); and social fitness did not emerge as a significant predictor for any state in the state-based analyses although was significant in the overall model (see Section 6.4.1.1). Figure 6.8 facilitates visual representation of all three types of testing detailed and their results. Such figures will be presented for all dependent variable models tested for investigation of emerging patterns in the discussion in Chapter 7.

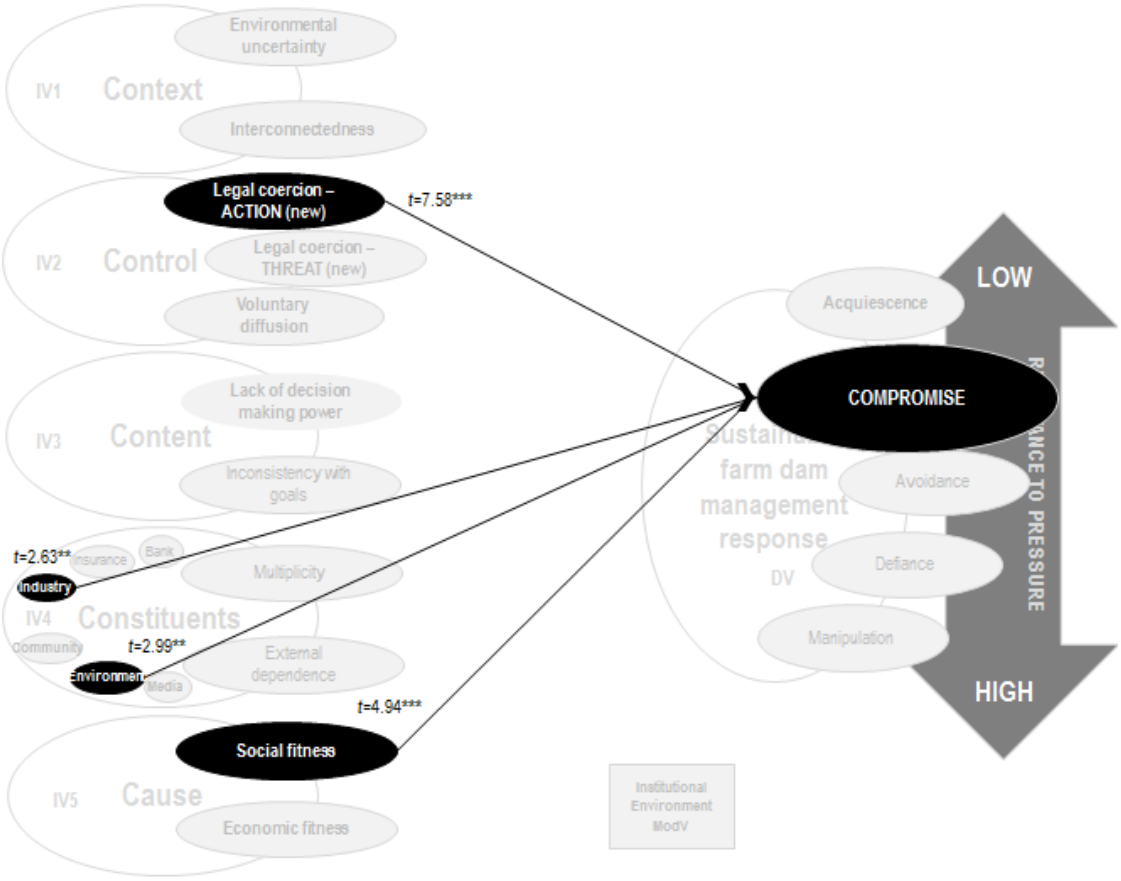
Figure 6.8 – Summary of results of statistical tests for the acquiescence model



6.4.2 Sustainable farm dam management response: Compromise

Representing a low farmer resistance to institutional pressures is the dependent variable compromise. Compromise was predicted by five independent variables, however the institutional environment of the farmer did not have a moderating effect on the model. Figure 6.9 highlights the statistical relationships discovered based on the model of hypothesised relationships in the conceptual model (Chapter 4, Figure 4.1).

Figure 6.9 - Statistical relationships of independent variables to dependent variable - Compromise



The following sections present the results of the multiple regression analysis for the compromise dependent variable model and the results of the model when it is moderated by the strength of the sustainable farm dam management institutional environment. In addition, a state-based multiple regression model is presented to provide further detail for results.

6.4.2.1 Multiple regression analysis - Compromise

Table 6.21 shows that the overall model for compromise was significant and the independent variables predicted 46.10% of the variability in a compromise response to institutional pressure ($F(18, 385) = 18.31$, $p<0.001$). The strongest predictor of a compromise response is the perceived legal coercion *action* ($\beta=0.36$, $t(403)=7.58$, $p<0.001$), followed by perceptions of social fitness within the institutional environment ($\beta=0.21$, $t(403)=4.94$, $p<0.001$). Farming industry group pressure is significant for this moderately passive compromise response of farmers to farm dam sustainability pressure ($\beta=0.11$, $t(403)=2.63^{**}$, $p<0.01$) as it is with the very passive acquiescent response, however in this model environmental group pressure is an additional predictor of a

compromise response to farm dam sustainability pressure (β=0.12, t(403)=2.99, p<0.01). Perceptions of economic fitness also predict this moderately passive response of compromising to farm dam sustainability pressures (β=0.10, t(403)=2.17, p<0.05).

Table 6.21 - Multiple regression analysis – Compromise

Variable	R^2 (%)	F	t	b	SE b	β
(Constant)	46.10	18.31***	1.58	0.58	0.37	
Environmental uncertainty (IV1a)			1.39	0.03	0.02	0.06
Inter-connectedness (IV1b)			0.99	0.04	0.04	0.04
Legal coercion-action (IV2a(i) new)			7.58***	0.36	0.05	0.36
Legal coercion-threat (IV2a(ii) new)			0.46	0.02	0.04	0.02
Voluntary diffusion (IV2b)			-0.82	-0.04	0.05	-0.04
Lack of decision making power (IV3a)			0.46	0.02	0.04	0.02
Inconsistency with goals (IV3b)			-1.05	-0.03	0.03	-0.05
Multiplicity (IV4a)			-1.94	-0.05	0.02	-0.09
Dependence on constituent (IV4b)			0.84	0.03	0.03	0.03
Industry body pressures (IV4 Sub1)			2.63**	0.07	0.03	0.11
Insurer pressures (IV4 Sub2)			-0.72	-0.02	0.03	-0.03
Bank pressures (IV4 Sub3)			0.75	0.03	0.04	0.03
Community group pressures (IV4 Sub4)			0.89	0.02	0.03	0.04
Environmental group pressures (IV4 Sub5)			2.99**	0.08	0.03	0.12
Media pressures (IV4 Sub 6)			-0.00	-0.09	0.05	0.00
Social fitness (IV5a)			4.94***	0.14	0.03	0.21
Economic fitness (IV5b)			2.17*	0.07	0.03	0.10
Institutional Environment (ModV)			-1.48	-0.03	0.02	-0.06

*n=404, *=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001*

6.4.2.2 Moderated multiple regression analysis – Compromise

Although the moderated model for compromise is significant, Table 6.22 shows the R^2 change indicates that there is no change in the predictive value of the model with the inclusion of the moderating variable on a compromise response to sustainable farm dam management (F(17,368)=0.28, p>0.05). In fact, the inclusion of the interaction terms reduced the F-statistic for the model, although it remained highlight significant (F(17,368) =9.25, p<0.001). In addition, there are no individually moderated relationships to report with all individual interactions between the independent institutional pressures and the moderating institutional environment having insignificant predictability for a compromise response.

Table 6.22 - Moderated multiple regression analysis – Compromise

Variable	R^2 (%)	$R^2\Delta$	*F*	*t*	*b*	*SE b*	*β*
(Constant)	46.80	0.70	9.25***	1.56	0.59	0.38	
Environmental uncertainty* Institutional Environment				0.67	0.02	0.03	0.03
Inter-connectedness* Institutional Environment				0.17	0.01	0.03	0.01
Legal coercion-action * Institutional Environment				0.46	0.01	0.03	0.02
Legal coercion- threat * Institutional Environment				-0.05	-0.00	0.03	0.00
Voluntary diffusion* Institutional Environment				0.91	0.03	0.03	0.05
Lack of decision making power* Institutional Environment				0.13	0.00	0.03	0.01
Inconsistency with goals* Institutional Environment				0.27	0.01	0.03	0.01
Multiplicity* Institutional Environment				-0.49	-0.02	0.03	-0.03
Dependence on constituent* Institutional Environment				0.22	0.01	0.03	0.01
Industry body pressures* Institutional Environment				-0.04	-0.00	0.03	-0.00
Insurer pressures* Institutional Environment				-0.59	-0.02	0.03	-0.03
Bank pressures* Institutional Environment				0.10	0.00	0.03	0.01
Community group pressures* Institutional Environment				0.13	0.00	0.03	0.01
Environmental group pressures* Institutional Environment				-0.81	-0.02	0.03	-0.04
Media pressures* Institutional Environment				0.25	0.01	0.03	0.01
Social fitness* Institutional Environment				0.30	0.01	0.03	0.01
Economic fitness* Institutional Environment				0.36	0.01	0.03	0.02

*n=404, *=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001*

6.4.2.3 State-based multiple regression analysis – Compromise

Each state was again separated into individual state samples for multiple regression analysis. All state's institutional pressure independent variable models were found to be significant predictors of the dependent variable compromise: the South Australian model predicted 41.80% of variance in compromise ($F(17,82)=3.46$, $p>0.001$), New South Wales 61.40% ($F(17,82)=7.85$, $p>0.001$), 55.60% in Victoria ($F(17,82)=6.18$, $p>0.001$), and 47.80% in Tasmania ($F(17,82)=4.42$, $p>0.001$) (Table 6.23).

Table 6.23 – State-based multiple regression analysis – Compromise

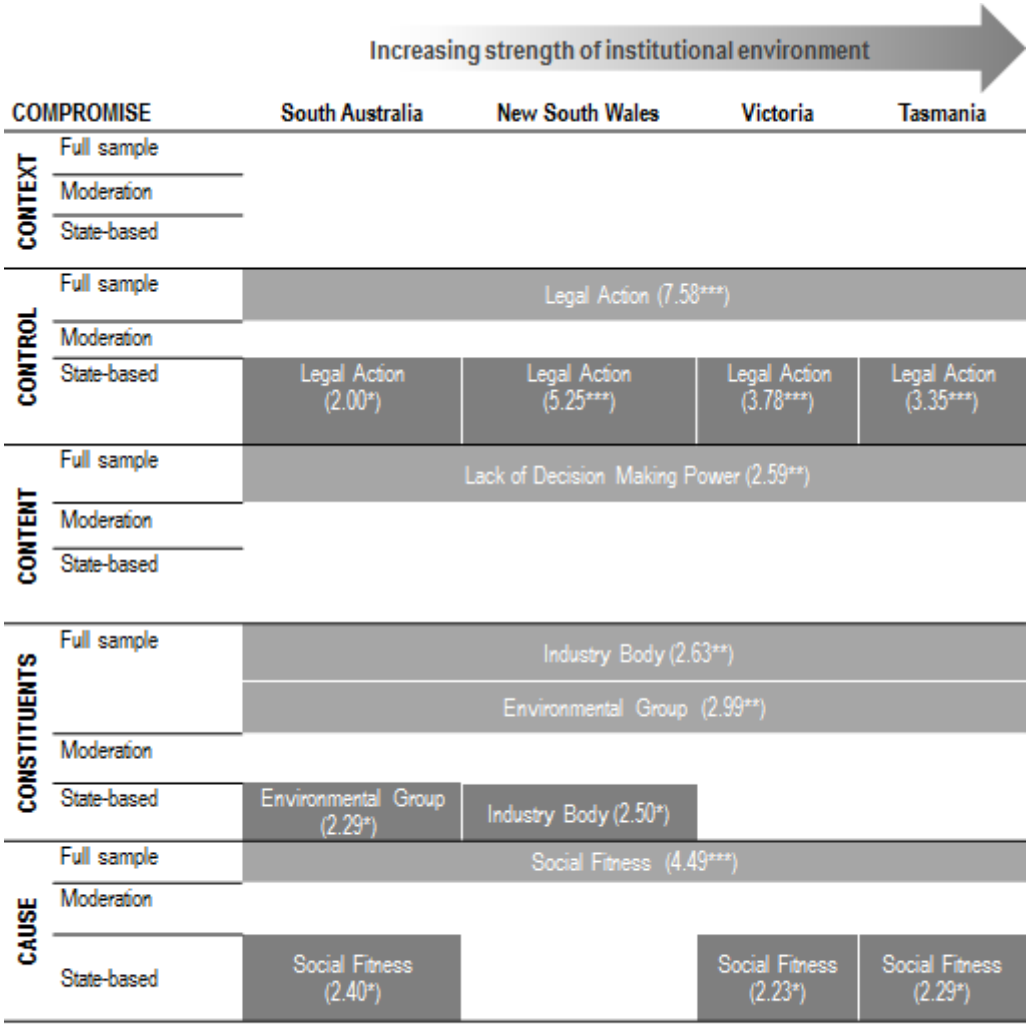
Test State	South Australia (*n*=100)						New South Wales (*n*=102)						Victoria (*n*=102)						Tasmania (*n*=100)					
Variable	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*
(Constant)	41.80	3.46***	1.89	1.86	0.99		61.40	7.85***	0.24	0.16	0.67		55.60	6.18***	-1.25	-0.98	0.79		47.80	4.42***	0.47	0.43	0.91	
Environmental uncertainty (IV1a)			-0.78	-0.04	0.05	-0.09			1.60	0.06	0.04	0.13			0.68	0.03	0.05	0.07			0.24	0.01	0.05	0.02
Inter-connectedness (IV1b)			0.34	0.04	0.10	0.04			-0.28	-0.02	0.08	-0.02			1.51	0.13	0.08	0.14			0.88	0.10	0.11	0.08
Legal coercion-action (IV2a(i) new)			2.00*	0.23	0.12	0.21			5.25***	0.60	0.11	0.54			3.78***	0.33	0.09	0.36			3.35***	0.37	0.11	0.36
Legal coercion-threat (IV2a(ii) new)			0.67	0.06	0.09	0.09			0.10	0.01	0.08	0.01			0.85	0.07	0.09	0.09			-0.09	-0.01	0.10	-0.01
Voluntary diffusion (IV2b)			-1.41	-0.19	0.14	-0.17			1.15	0.11	0.10	0.11			-1.44	-0.14	0.10	-0.15			0.65	0.07	0.10	0.07
Lack of decision making power (IV3a)			1.16	0.11	0.09	0.13			1.38	0.09	0.06	0.11			1.54	0.12	0.08	0.15			1.22	0.11	0.09	0.12
Inconsistency with goals (IV3b)			0.28	0.02	0.06	0.03			1.42	0.09	0.07	0.12			-0.30	-0.02	0.06	-0.03			-0.14	-0.01	0.07	-0.02
Multiplicity (IV4a)			-0.37	-0.02	0.05	-0.05			-0.21	-0.01	0.05	-0.02			-1.48	-0.08	0.05	-0.14			-0.59	-0.03	0.06	-0.06
Dependence on constituent (IV4b)			0.42	0.03	0.08	0.04			0.49	0.03	0.07	0.04			1.61	0.11	0.07	0.13			0.61	0.05	0.08	0.06
Industry pressures (IV4 Sub1)			1.20	0.07	0.06	0.12			2.50*	0.13	0.05	0.22			1.79	0.10	0.06	0.16			0.31	0.02	0.07	0.03
Insurer pressures (IV4 Sub2)			0.44	0.04	0.08	0.04			-1.65	-0.11	0.07	-0.13			1.13	0.08	0.07	0.11			-1.29	-0.09	0.07	-0.12
Bank pressures (IV4 Sub3)			-1.27	-0.14	0.11	-0.12			0.71	0.06	0.09	0.07			0.99	0.09	0.09	0.09			-0.31	-0.02	0.06	-0.03
Community group pressures (IV4 Sub4)			0.73	0.04	0.06	0.07			-1.70	-0.09	0.05	-0.14			0.17	0.01	0.05	0.02			0.88	0.05	0.06	0.08
Environmental group pressures (IV4 Sub5)			2.29*	0.13	0.06	0.23			1.77	0.11	0.07	0.16			1.28	0.07	0.05	0.10			1.68	0.11	0.06	0.16
Media pressures (IV4 Sub 6)			-0.71	-0.07	0.10	-0.07			-0.03	-0.00	0.11	-0.00			0.78	0.06	0.08	0.06			-0.24	-0.04	0.15	-0.02
Social fitness (IV5a)			2.40*	0.16	0.07	0.24			1.14	0.06	0.06	0.10			2.23*	0.15	0.07	0.21			2.29*	0.16	0.07	0.23
Economic fitness (IV5b)			0.88	0.06	0.07	0.09			-0.23	-0.01	0.06	-0.02			0.56	0.05	0.07	0.07			0.72	0.05	0.07	0.07

=sig.@p<0.05, **=sig.@p<0.01, *=sig.@p<0.001*

The moderated multiple regression presented in Section 6.4.2.2 did not find any significant relationships for compromise moderated by the strength of the sustainable farm dam management institutional environment. The state-based analysis supports this result, finding patterns across several states and similarities with farmers having a 'compromising' response to sustainable farm dam management pressure. Legal coercion action was a significant predictor of a compromise response across all states (SA: β=0.21, t(100)=2.00, p<0.05; NSW: β=0.54, t(102)=5.25, p<0.001; VIC: β=0.36, t(102)=3.78, p<0.001; TAS: β=0.36, t(100)=3.35, p<0.001), and social fitness was also a significant predictor across all states, with the exception of New South Wales (SA: β=0.24, t(100)=2.40, p<0.05; VIC: β=0.21, t(102)=2.23, p<0.05; TAS: β=0.23, t(100)=2.29, p<0.05).

The support for these as predictors of compromise is also evidenced in the full regression model where strongly significant relationships were found. Other relationships that emerged in this section were industry bodies' involvement in New South Wales (β=0.22, t(102)=2.50, p<0.05) and environmental group involvement in in South Australia (β=0.23, t(100)=2.29, p<0.05) – both locations in the weak range of sustainable farm dam management institutional environment strength and these institutional actor's involvements predicted low resistance to sustainable farm dam management pressure. Figure 6.10 highlights visually the results of each test of the data, representing the patterns that emerge with legal coercion action and social fitness as strong predictors of low resistance to sustainable farm dam management institutional pressure.

Figure 6.10 – Summary of results of statistical tests for the compromise model



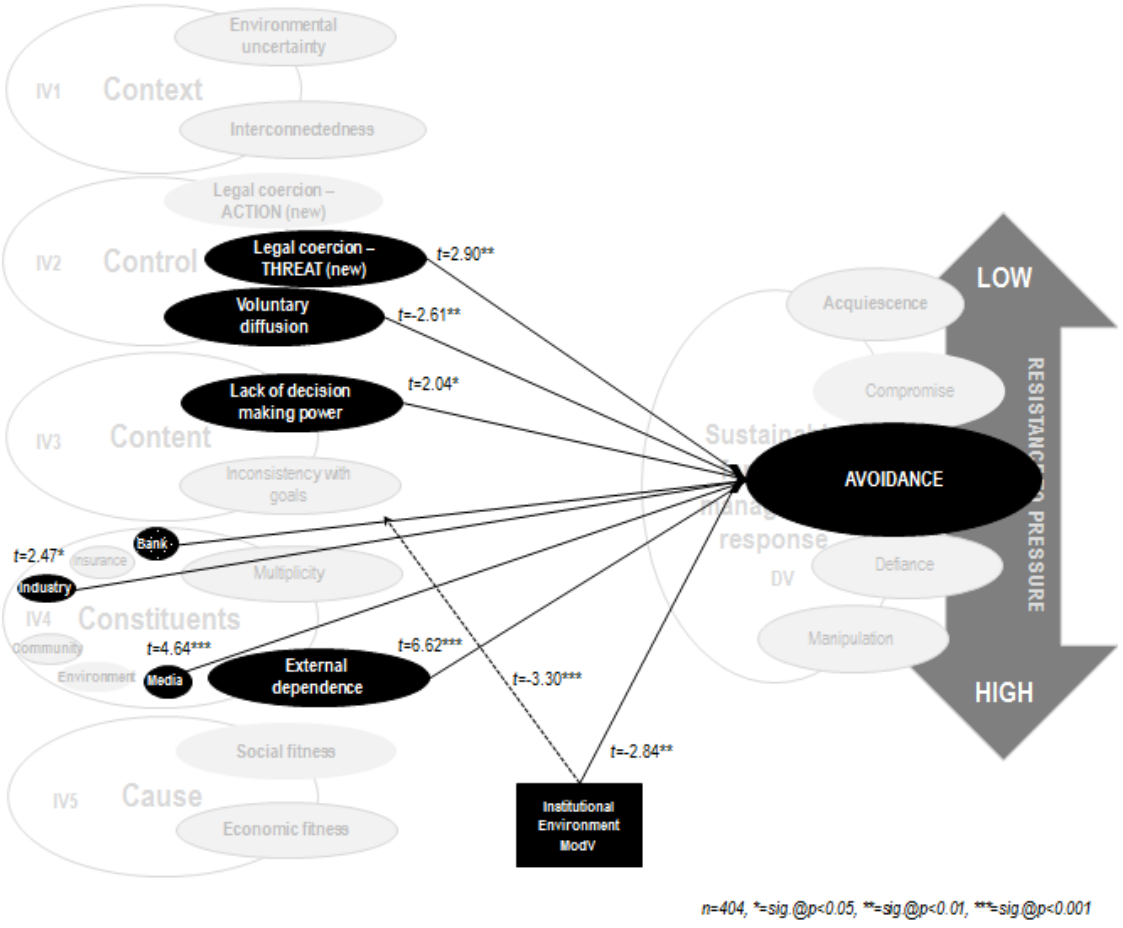
*=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001

The relationships that emerge above and that appear in Figure 6.10 will be discussed further in Chapter 7. The following section discusses the next dependent variable model – avoidance.

6.4.3 Sustainable farm dam management response: Avoidance

The mid-range of farmer resistance to institutional pressure is represented by the dependent variable avoidance. Avoidance of institutional pressure was predicted by seven independent variables and the institutional environment of the farmer and a moderated relationship was found. The relationships of interest as predicted by the moderated multiple regression model are demonstrated on Figure 6.10 which highlights the statistical predictors of variance in avoidance within the model of hypothesised relationships.

Figure 6.11 - Statistical relationships of independent variables to dependent variable - Avoidance



The following three sections present the results of the multiple regression model for the dependent variable avoidance, the result when the model is moderated by the strength of the institutional environment, followed by the state-based multiple regression analysis.

6.4.3.1 Multiple regression analysis – Avoidance

Table 6.24 shows that the overall model for avoidance was significant and the independent variables of institutional pressure predicted 30.80% of the variance in an avoidance response (F (18, 385) =9.51, p<0.001). The strongest predictor of an avoidance response was external dependence on government actors within the institutional field (β=0.30, t(403)=6.62, p<0.001) followed by media pressure (β=0.21, t(403)=4.64, p<0.001). Also a strong predictor was the threat of legal coercion (β=0.17, t(403)=2.90, p<0.01). A lack of decision making power also strongly predicted an avoidance response (β=0.10, t(403)=2.04, p<0.05) as did industry body pressure (β=0.12, t(403)=2.47, p<0.05). Interestingly, voluntary diffusion of dam management rules and norms negatively predicted an avoidance response (β=-0.14, t(403)=2.61, p<0.01), that is, if the roles and norms are not well dispersed throughout a region or industry, then farmers will be more likely to avoid the pressure of the rules and norms.

Table 6.24 - Multiple regression analysis – Avoidance

Variable	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*
(Constant)	30.80	9.51***	7.39***	2.45	0.33	
Environmental uncertainty (IV1a)			-0.91	-0.02	0.02	-0.05
Inter-connectedness (IV1b)			-0.10	-0.00	0.04	-0.01
Legal coercion-action (IV2a(i) new)			-0.75	-0.03	0.04	-0.04
Legal coercion-threat (IV2a(ii) new)			2.90**	0.11	0.04	0.17
Voluntary diffusion (IV2b)			-2.61**	-0.12	0.05	-0.14
Lack of decision making power (IV3a)			2.44*	0.07	0.03	0.10
Inconsistency with goals (IV3b)			0.38	0.01	0.03	0.02
Multiplicity (IV4a)			0.88	0.02	0.02	0.05
Dependence on constituent (IV4b)			6.62***	0.20	0.03	0.30
Industry body pressures (IV4 Sub1)			2.47*	0.06	0.02	0.12
Insurer pressures (IV4 Sub2)			-0.60	-0.02	0.03	-0.03
Bank pressures (IV4 Sub3)			0.10	0.00	0.03	0.01
Community group pressures (IV4 Sub4)			1.28	0.03	0.02	0.06
Environmental group pressures (IV4 Sub5)			-0.43	-0.01	0.02	-0.02
Media pressures (IV4 Sub 6)			4.64***	0.20	0.04	0.21
Social fitness (IV5a)			-1.69	-0.04	0.03	-0.08
Economic fitness (IV5b)			0.84	0.02	0.03	0.04
Institutional Environment (ModV)			-2.84**	-0.06	0.03	-0.13

*n=404, *=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001*

6.4.3.2 Moderated multiple regression analysis – Avoidance

The moderated model of avoidance (Table 6.25) is significant ($F(17,368)=5.45$, $p<0.001$) however the R^2 change did not improve and was not significant ($F(17,368)=1.10$, $p>0.05$) indicating the there was no moderating effect of institutional environment on the power of institutional antecedents to predict an avoidance response to sustainable farm dam management pressure overall. However, one relationship was significant and that was for banking pressure (β =-0.17, $t(403)=-3.30$, $p<0.001$).

Table 6.25 - Moderated multiple regression analysis – Avoidance

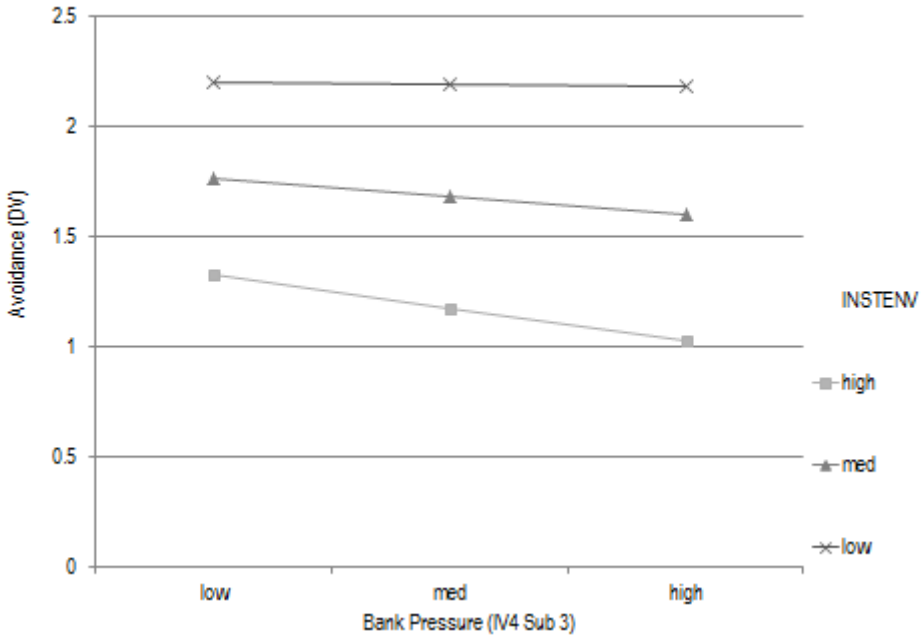
Variable	R^2 (%)	$R^2\Delta$	*F*	*t*	*b*	*SE b*	*β*
(Constant)	34.10	3.30	5.45***	7.00***	2.35	0.34	
Environmental uncertainty* Institutional Environment				0.29	0.01	0.03	0.02
Inter-connectedness* Institutional Environment				-0.71	-0.02	0.03	-0.03
Legal coercion-action * Institutional Environment				-0.00	0.70	0.03	0.00
Legal coercion- threat * Institutional Environment				0.28	0.01	0.03	0.02
Voluntary diffusion* Institutional Environment				-0.06	-0.01	0.03	-0.00
Lack of decision making power* Institutional Environment				-0.42	-0.01	0.03	-0.02
Inconsistency with goals* Institutional Environment				0.47	0.01	0.03	0.03
Multiplicity* Institutional Environment				0.17	0.01	0.03	0.01
Dependence on constituent* Institutional Environment				-0.61	-0.02	0.02	-0.03
Industry body pressures* Institutional Environment				0.35	0.01	0.03	0.02
Insurer pressures* Institutional Environment				-0.69	-0.02	0.02	-0.03
Bank pressures* Institutional Environment				-3.30***	-0.08	0.02	-0.17
Community group pressures* Institutional Environment				-0.04	-0.00	0.02	-0.00
Environmental group pressures* Institutional Environment				1.54	0.04	0.02	0.08
Media pressures* Institutional Environment				0.90	0.02	0.03	0.04
Social fitness* Institutional Environment				-0.54	-0.01	0.03	-0.03
Economic fitness* Institutional Environment				0.77	0.02	0.03	0.04

*n=404, *=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001*

The results indicate that in a high sustainable farm dam pressure institutional environment, the pressure from a farmer's bank to manage their dam asset sustainably is more likely to

predict an avoidance response. Figure 6.12 plots the regression equation for the four values of the DV as per the method presented in Section 6.4.1.2 in order to demonstrate the direction of the result.

Figure 6.12 - Moderation of the effect of banking pressure on an avoidance response to sustainable farm dam management pressure by the institutional environment



The graphical representation of the interaction term's relationship to the independent and dependent variables, plotted in Figure 6.12, indicates that for farmers managing their farm dams in strong and well integrated institutional environments, farm dam sustainability pressure from the farmer's bank is negatively associated with an avoidance response to pressure to manage dams sustainably. Although the graphs do not show dramatic slopes, generally, at low levels of bank pressure, there was little relationship between levels of strength of institutional environment and avoidance, whereas at high levels of bank pressure, strength of the institutional environment was responsible for the variation in avoidance of institutional pressure. This relationship is discussed further in the following section.

6.4.3.3 State-based multiple regression analysis – Avoidance

When each state was extracted from the total sample for inclusion in individual regression analyses for the avoidance model, all models significantly predicted avoidance: in SA 27.30% ($F(17,82)=1.81$, $p<0.05$), New South Wales 55.90% ($F(17,82)=6.26$, $p<0.001$), Victoria 41.40% ($F(17,82)=3.49$, $p<0.001$), and Tasmania 33.60% ($F(17,82)=2.44$, $p<0.01$) (Table 6.26).

Table 6.26 – State-based multiple regression analysis – Avoidance

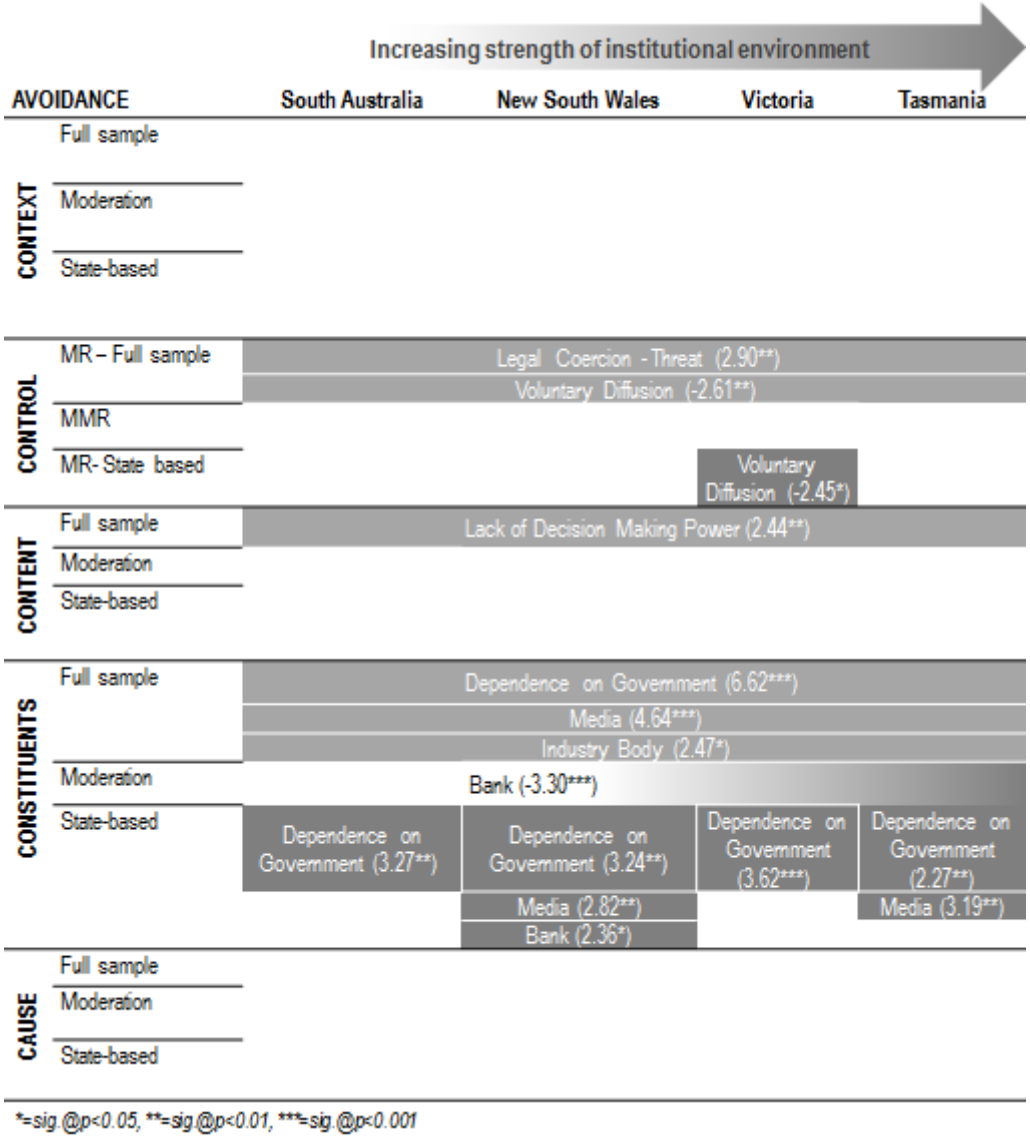
Test State	South Australia (*n*=100)						New South Wales (*n*=102)						Victoria (*n*=102)						Tasmania (*n*=100)					
Variable	**R^2 (%)**	***F***	***t***	***b***	***SE b***	***β***	**R^2 (%)**	***F***	***t***	***b***	***SE b***	***β***	**R^2 (%)**	***F***	***t***	***b***	***SE b***	***β***	**R^2 (%)**	***F***	***t***	***b***	***SE b***	***β***
(Constant)	27.30	1.81*	5.27***	3.81	0.72		55.90	6.26***	0.44	0.30	0.68		41.40	3.49***	4.30***	2.91	0.68		33.60	2.44**	2.33*	1.96	0.84	
Environmental uncertainty (IV1a)			0.31	0.01	0.04	0.04			-1.25	-0.05	0.04	-0.11			0.04	0.00	0.04	0.00			-0.46	-0.02	0.05	-0.05
Inter-connectedness (IV1b)			-0.06	-0.00	0.08	-0.01			0.56	0.04	0.08	0.05			-0.24	-0.02	0.07	-0.03			0.05	-0.01	0.10	-0.01
Legal coercion-action (IV2a(i) new)			-0.16	-0.01	0.08	-0.02			-1.13	-0.13	0.11	-0.12			-0.27	-0.02	0.08	-0.03			-0.67	-0.07	0.10	-0.08
Legal coercion-threat (IV2a(ii) new)			1.25	0.08	0.07	0.19			1.74	0.15	0.09	0.18			1.38	0.10	0.07	0.17			1.52	0.14	0.09	0.19
Voluntary diffusion (IV2b)			-1.85	-0.19	0.10	-0.25			0.42	0.04	0.10	0.04			-2.35*	-0.20	0.09	-0.27			-0.75	-0.07	0.10	-0.09
Lack of decision making pwr (IV3a)			0.93	0.06	0.07	0.12			1.47	0.09	0.06	0.13			-0.33	-0.02	0.07	-0.04			0.27	0.02	0.08	0.03
Inconsistency with goals (IV3b)			0.63	0.03	0.05	0.07			-0.32	-0.02	0.05	-*0.03			-0.10	-0.01	0.05	-0.01			0.73	0.05	0.06	0.10
Multiplicity (IV4a)			-0.54	-0.02	0.04	-0.07			1.24	0.06	0.05	0.12			1.91	0.08	0.04	0.21			-0.49	-0.03	0.05	-0.06
Dependence on constituent (IV4b)			3.27**	0.18	0.06	0.32			3.24**	0.22	0.07	0.28			3.62***	0.21	0.06	0.33			2.27*	0.18	0.08	0.25
Industry pressures (IV4 Sub1)			0.39	0.02	0.04	0.04			1.80	0.09	0.05	0.17			2.24*	0.11	0.05	0.23			0.86	0.05	0.06	0.10
Insurer pressures (IV4 Sub2)			-0.97	-0.06	0.06	-0.11			0.78	0.01	0.07	0.02			-0.54	-0.03	0.06	-0.06			-1.67	-0.11	0.06	-0.18
Bank pressures (IV4 Sub3)			0.50	0.04	0.08	0.05			2.36*	0.21	0.09	0.26			-0.19	-0.01	0.08	-0.02			-1.99*	-0.09	0.05	-0.29
Community group pressures (IV4 Sub4)			1.11	0.05	0.04	0.12			0.08	0.01	0.05	0.01			0.73	0.03	0.05	0.07			1.16	0.06	0.05	0.13
Environmental group pressures (IV4 Sub5)			1.12	0.04	0.04	0.09			-0.76	-0.05	0.07	-0.07			1.21	0.06	0.05	0.11			-0.06	-0.00	0.06	-0.01
Media pressures (IV4 Sub 6)			0.46	0.03	0.07	0.05			2.82**	0.32	0.11	0.29			1.30	0.09	0.07	0.12			3.19**	0.43	0.14	0.34
Social fitness (IV5a)			-0.29	-0.01	0.05	-0.03			-0.99	-0.05	0.06	-0.09			-1.24	-0.07	0.06	-0.13			-0.99	-0.06	0.06	-0.11
Economic fitness (IV5b)			0.96	0.05	0.05	0.11			-0.28	-0.02	0.06	-0.03			0.64	0.04	0.06	0.07			0.86	0.06	0.07	0.10

=sig.@p<0.05, **=sig.@p<0.01, *=sig.@p<0.001*

The moderated model for avoidance supports the moderated regression results, finding a negative relationship between bank pressure and an avoidance strategy in a strong sustainable farm dam management institutional environment. The state-based analysis highlights that bank pressure is a positive predictor of avoidance in the strong institutional environment in Tasmania (β=-0.29, t(100)=-1.99, p<0.05) (see Figure 6.12 for the moderated multiple regression relationship). By contrast, in New South Wales, bank pressure is a positive predictor of avoidance (β=0.26, t(102)=2.36, p<0.05). That is, if farmers perceive banks are placing increasing pressure on them to manage farm dams sustainably, farmers may strategically avoid pressure and conceal or disguise bad practice.

Most of the other relationships found in the multiple regressions of the full sample are supported by the state-based analysis with the exception of the threat of legal coercion, in addition to lack of decision making power, both not significantly predicting variability in avoidance for any institutional environment. Both independent variables were significant predictors in the full model. Figure 6.13 highlights visually the results of each test of the data, representing the patterns that are emerging with predictors of low-medium resistance to sustainable farm dam management institutional pressure in varying strengths of institutional environments across test states.

Figure 6.13 –Summary of results of statistical tests for the avoidance model

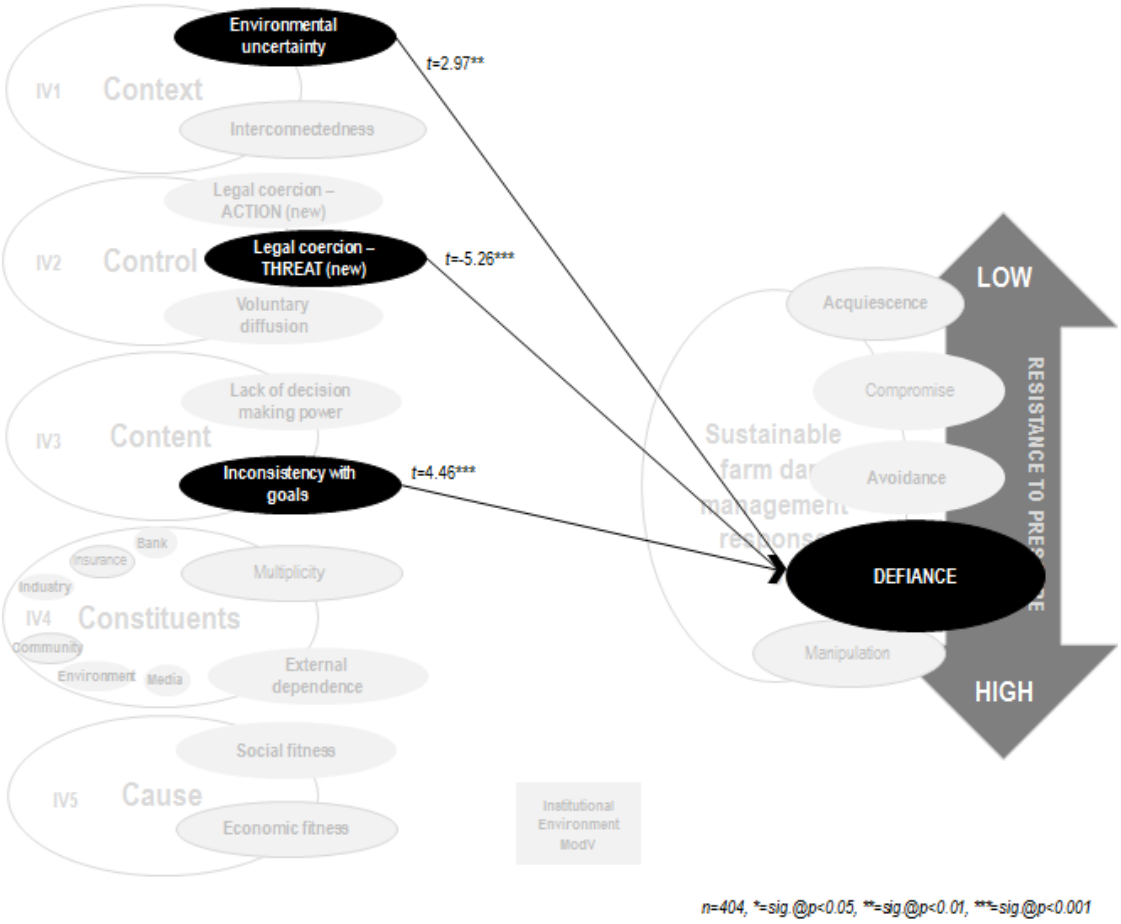


*=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001

6.4.4 Sustainable farm dam management response: Defiance

Representing a higher farmer resistance to institutional pressures is the dependent variable defiance. Defiance of institutional pressure was predicted by only three independent variables and the institutional environment of the farmer did not have a moderating effect on the model. The relationships of interest as predicted by the moderated multiple regression model are demonstrated on Figure 6.14 which highlights the statistical predictors of variance in defiance within the model of hypothesised relationships.

Figure 6.14 - Statistical relationships of independent variables to dependent variable - Defiance



The three sections following present the results of the defiance multiple regression model, the results of the model when it is moderated by the strength of the institutional environment in addition to a state-based multiple regression analysis for the defiance model.

6.4.4.1 Multiple regression analysis - Defiance

Table 6.27 highlights that the model for compromise was significant overall and the independent variables of institutional pressure predicted 29.70% of the variance in a defiance response ($F(18,385) = 9.04$, $p<0.001$). All the predictors that were significant for the defiance model were positive and strong but the strongest predictor of defiance of sustainable farm dam pressures was the threat of legal coercion ($\beta = 0.31$, $t(403)=5.26$, $p<0.001$) suggesting that as the threat of penalties and fines increases, as does defiance in the face of this pressure. This was followed by inconsistency with farmer goals which also strongly significantly predicted a defiance response ($\beta = 0.22$, $t(403)=4.46$, $p<0.001$). Environmental uncertainty was also a strong significant predictor of defiance of sustainable farm dam management pressure ($\beta = 0.15$, $t(403)=2.97$, $p<0.001$) which indicates that as a

farmer's environment becomes more uncertain with regard to their surface water storage, so does their desire to defy institutional pressures for farm dam sustainability. Community group pressure was also a significant predictor of defiance to institutional pressure to manage dams sustainably.

Table 6.27 - Multiple regression analysis – Defiance

Variable	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*
(Constant)	29.70	9.04***	3.90***	2.16	0.55	
Environmental uncertainty (IV1a)			2.97**	010	0.03	0.15
Inter-connectedness (IV1b)			0.87	0.06	0.06	0.04
Legal coercion-action (IV2a(i) new)			0.53	0.04	0.07	0.03
Legal coercion-threat (IV2a(ii) new)			5.26***	0.32	0.06	0.31
Voluntary diffusion (IV2b)			-1.37	-0.10	0.08	-0.07
Lack of decision making power (IV3a)			-1.46	-0.08	0.06	-0.07
Inconsistency with goals (IV3b)			4.46***	0.19	0.04	0.22
Multiplicity (IV4a)			0.91	0.03	0.04	0.05
Dependence on constituent (IV4b)			-0.63	-0.03	0.05	-0.03
Industry body pressures (IV4 Sub1)			-0.42	-0.02	0.04	-0.02
Insurer pressures (IV4 Sub2)			-1.03	-0.05	0.05	-0.05
Bank pressures (IV4 Sub3)			-0.80	-0.04	0.05	-0.04
Community group pressures (IV4 Sub4)			2.07*	0.08	0.04	0.10
Environmental group pressures (IV4 Sub5)			0.45	0.02	0.04	0.02
Media pressures (IV4 Sub 6)			-0.82	-0.06	0.07	-0.04
Social fitness (IV5a)			1.46	0.06	0.04	0.07
Economic fitness (IV5b)			0.69	0.03	0.05	0.04
Institutional Environment (ModV)			-0.33	-0.01	0.03	-0.02

*n=404, *=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001*

6.4.4.2 Moderated multiple regression analysis - Defiance

The moderated model for defiance is significant ($F(17,368)=5.03$, $p<0.001$) (Table 6.28) however the R^2 change did not improve and was not significant ($F(17,368)=0.03$, $p>0.05$) indicating there is no overall moderated effect of the institutional environment on a defiant response to sustainable farm dam management pressures. No individual institutional pressures gave evidence of an interaction effect either so the moderation of the environment was not significant at all in increasing the predictive power of institutional pressure.

Table 6.28 - Moderated multiple regression analysis – Defiance

Variable	R^2 (%)	$R^2\Delta$	*F*	*t*	*b*	*SE b*	*β*
(Constant)	32.40	2.60	5.03***	3.86***	2.18	0.56	
Environmental uncertainty* Institutional Environment				0.34	0.02	0.04	0.02
Inter-connectedness* Institutional Environment				0.45	0.02	0.05	0.02
Legal coercion-action * Institutional Environment				-1.13	-0.05	0.05	-0.06
Legal coercion- threat * Institutional Environment				0.48	0.02	0.05	0.03
Voluntary diffusion* Institutional Environment				-0.52	-0.03	0.05	-0.03
Lack of decision making power* Institutional Environment				0.62	0.03	0.05	0.03
Inconsistency with goals* Institutional Environment				-0.72	-0.03	0.04	-0.04
Multiplicity* Institutional Environment				-0.67	-0.02	0.05	-0.02
Dependence on constituent* Institutional Environment				1.23	0.05	0.04	0.06
Industry body pressures* Institutional Environment				1.34	0.06	0.04	0.07
Insurer pressures* Institutional Environment				-0.87	-0.04	0.04	-0.04
Bank pressures* Institutional Environment				0.06	0.00	0.04	0.00
Community group pressures* Institutional Environment				-0.78	-0.03	0.04	-0.04
Environmental group pressures* Institutional Environment				0.97	0.04	0.04	0.05
Media pressures* Institutional Environment				-1.72	-0.07	0.04	-0.08
Social fitness* Institutional Environment				0.38	0.02	0.04	0.02
Economic fitness* Institutional Environment				-1.05	-0.05	0.04	-0.05

*n=404, *=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001*

6.4.4.3 State-based multiple regression analysis – Defiance

The state-based multiple regression models were all significant predictors of a defiance response, with South Australia's model predicting 39.20% of variance in defiance ($F(17,82)=3.10$, $p<0.001$), New South Wales 38.20% ($F(17,82)=3.06$, $p<0.001$), Victoria's model predicting 39.30% ($F(17,82)=3.07$, $p<0.001$), and Tasmania's 40.40% ($F(17,82)=3.27$, $p<0.001$) (Table 6.29).

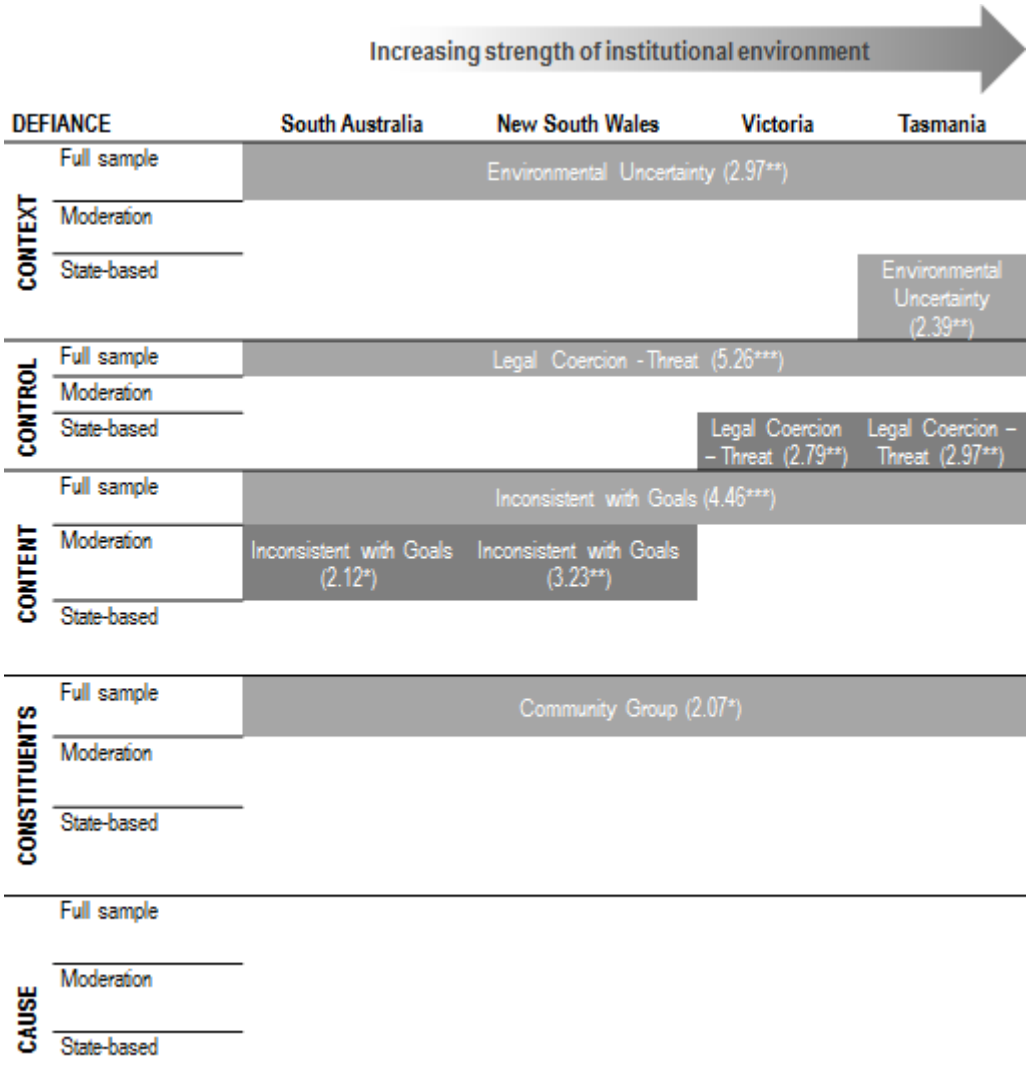
Table 6.29 – State-based multiple regression analysis – Defiance

Test State	South Australia (*n*=100)						New South Wales (*n*=102)						Victoria (*n*=102)						Tasmania (*n*=100)					
Variable	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*
(Constant)	39.20	3.10***	2.00*	2.92	1.46		38.20	3.06***	-0.53	0.61	1.51		39.30	3.07***	2.99**	3.60	1.20		40.40	3.27***	2.88**	3.45	1.20	
Environmental uncertainty (IV1a)			1.59	0.12	0.08	0.19			1.83	0.12	0.07	0.19			1.07	0.08	0.08	0.13			2.39**	0.16	0.07	0.25
Inter-connectedness (IV1b)			0.22	0.03	0.15	0.02			0.16	0.02	0.13	0.02			0.82	0.10	0.13	0.09			-0.42	-0.06	0.14	-0.04
Legal coercion-action (IV2a(i) new)			0.55	0.09	0.17	0.06			1.85	0.36	0.19	0.24			-0.85	-0.11	0.13	-0.09			0.28	0.04	0.14	0.03
Legal coercion-threat (IV2a(ii) new)			0.56	0.09	0.18	0.07			1.43	0.21	0.15	0.18			2.79**	0.37	0.13	0.35			2.97**	0.39	0.13	0.36
Voluntary diffusion (IV2b)			-0.76	-0.15	0.20	-0.09			0.05	0.01	0.17	0.01			-0.20	-0.03	0.15	-0.02			-1.60	-0.22	0.14	-0.17
Lack of decision making power (IV3a)			-1.07	-0.15	0.14	-0.12			-1.55	-0.17	0.11	-0.16			-1.15	-0.14	0.12	-0.13			-0.51	-0.06	0.11	-0.06
Inconsistency with goals (IV3b)			2.12*	0.20	0.09	0.23			3.23**	0.29	0.09	0.31			0.77	0.07	0.09	0.08			1.39	0.12	0.09	0.17
Multiplicity (IV4a)			0.83	0.07	0.08	0.10			0.74	0.07	0.09	0.08			1.59	0.12	0.08	0.18			0.47	0.04	0.07	0.05
Dependence on constituent (IV4b)			-1.27	-0.14	0.11	-0.12			-0.39	-0.05	0.12	-0.04			-0.84	-0.08	0.10	-0.08			0.70	0.08	0.11	0.07
Industry pressures (IV4 Sub1)			0.84	0.08	0.09	0.11			0.72	0.06	0.09	0.08			1.07	0.09	0.09	0.11			-0.11	-0.01	0.09	-0.01
Insurer pressures (IV4 Sub2)			-0.65	-0.08	0.13	-0.07			0.60	0.07	0.11	0.06			-1.08	-0.12	0.11	-0.12			-1.02	-0.09	0.09	-0.10
Bank pressures (IV4 Sub3)			-0.22	-0.03	0.16	-0.02			-0.97	-0.15	0.15	-0.13			-1.14	-0.15	0.14	-0.12			-0.27	-0.02	0.08	-0.03
Community group pressures (IV4 Sub4)			1.61	0.13	0.08	0.15			1.13	0.10	0.09	0.12			0.24	0.02	0.08	0.03			1.21	0.09	0.07	0.13
Environmental group pressures (IV4 Sub5)			0.15	0.01	0.09	0.02			-1.80	-0.20	0.11	-0.20			0.25	0.02	0.08	0.04			0.44	0.04	0.08	0.05
Media pressures (IV4 Sub 6)			0.13	0.02	0.15	0.01			1.30	0.25	0.19	0.16			-1.63	-0.20	0.12	-0.15			-1.42	-0.27	0.19	-0.14
Social fitness (IV5a)			0.83	0.08	0.10	0.09			0.55	0.05	0.09	0.06			0.11	0.01	0.11	0.01			0.79	0.07	0.09	0.09
Economic fitness (IV5b)			0.53	0.05	0.10	0.05			1.06	0.11	0.11	0.12			0.71	0.08	0.11	0.08			-1.35	-0.13	0.09	-0.14

=sig.@p<0.05, **=sig.@p<0.01, *=sig.@p<0.001*

No moderating from the strength of the sustainable farm dam management institutional environment effect was detected in Section 6.4.4.2 when the full sample was tested for the defiance regression model. However, the state-based multiple regression analysis does identify two patterns emerging that would suggest a relationship to strength of the farm dam institutional environment: Inconsistency with goals is significant in the weaker institutional environments of South Australia (β =0.23, t(100)=-2.12, p<0.05) and New South Wales (β =0.31, t(102)=3.23, p<0.01); and, the threat of legal coercion is a predictor only in the strong farm dam institutional environment states of Victoria (β =0.35, t(102)=2.79, p<0.01) and Tasmania (β =0.36, t(100)=2.97, p<0.01). All other relationships identified in the full sample are supported and Figure 6.15 highlights the state-based results mapped onto the results of the multiple regression of the full sample.

Figure 6.15 –Summary of results of statistical tests for the defiance model



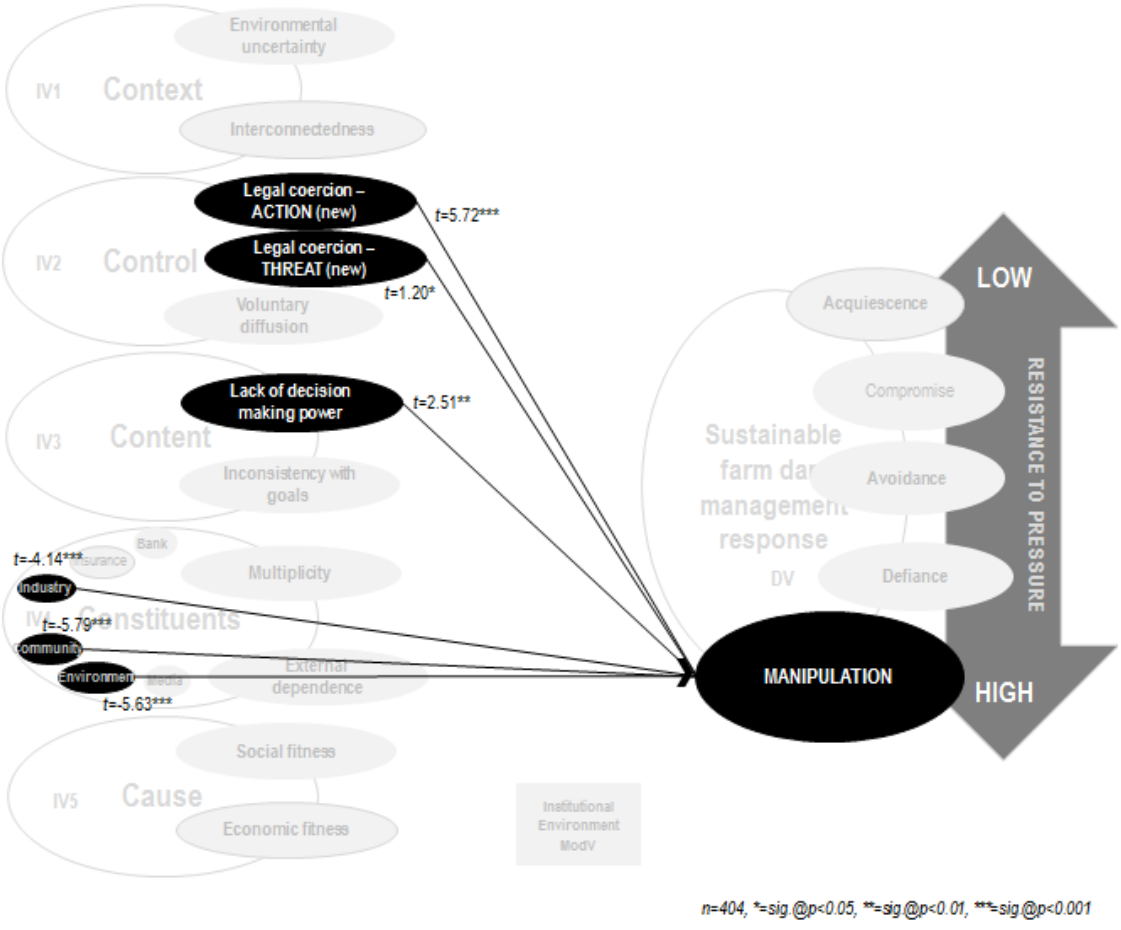
*=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001

The following section will discuss the results of the final dependent variable model, manipulation.

6.4.5 Sustainable farm dam management response: Manipulation

The highest farmer resistance to institutional pressure is represented by the dependent variable manipulation. Manipulation of institutional pressure was predicted by seven independent variables however the institutional environment of the farmer did not have a moderating effect on the relationships. The relationships of the institutional pressures on a manipulative sustainable farm dam management response are demonstrated on Figure 6.16, which highlights the statistical predictors of variance in manipulation based on the conceptual model developed in Chapter 4 (Figure 4.1).

Figure 6.16 - Statistical relationships of independent variables to dependent variable - Manipulation



The following three sections present the results of the multiple regression model for the dependent variable manipulation, the result when the model is moderated by the strength of the institutional environment, and the state-by-state multiple regression results.

6.4.5.1 Multiple regression analysis – Manipulation

Table 6.30 highlights that the model for manipulation was significant overall and the institutional pressure variables were significant in predicting variability in a manipulation

response to pressure (F(18, 385) =21.44, p<0.001). The strongest, although negative predictor of manipulation was community group pressure (β =-0.24, t (403) =-5.79, p<0.001). Environmental group involvement was also a negative and strongly significant predictor of a manipulation strategy (β =-0.22, t (403) =-5.63, p<0.001) followed by industry body pressure (β =-0.17, t (403) =-4.14, p<0.001). Legal coercion – action was also strong and positively predicting a manipulation response (β =0.26, t (403) =5.72, p<0.001). Lack of decision making power regarding farm dam management also predicted the strongly resistant manipulative response to sustainable farm dam management pressure (β =0.11, t (403) =2.51, p<0.05) as did the more general threat of legal coercion (β =0.10, t (403) =1.20, p<0.05).

Table 6.30 - Multiple regression analysis – Manipulation

Variable	R^2 (%)	F	t	b	SE b	β
(Constant)	50.10	21.44***	1.73	0.59	0.34	
Environmental uncertainty (IV1a)			1.34	0.03	0.02	0.06
Inter-connectedness (IV1b)			1.17	0.05	0.04	0.05
Legal coercion-action (IV2a(i) new)			5.72***	0.25	0.04	0.26
Legal coercion-threat (IV2a(ii) new)			1.20*	0.08	0.04	0.10
Voluntary diffusion (IV2b)			-0.73	-0.03	0.05	-0.03
Lack of decision making power (IV3a)			2.51*	0.08	0.03	0.11
Inconsistency with goals (IV3b)			-1.55	-0.04	0.03	-0.06
Multiplicity (IV4a)			-1.62	-0.04	0.02	-0.07
Dependence on constituent (IV4b)			1.70	0.05	0.03	0.07
Industry body pressures (IV4 Sub1)			-4.14***	-0.10	0.03	-0.17
Insurer pressures (IV4 Sub2)			-0.27	-0.01	0.03	-0.01
Bank pressures (IV4 Sub3)			0.07	0.00	0.03	0.00
Community group pressures (IV4 Sub4)			-5.79***	-0.14	0.02	-0.24
Environmental group pressures (IV4 Sub5)			-5.63***	-0.14	0.03	-0.22
Media pressures (IV4 Sub 6)			1.18	0.05	0.04	0.05
Social fitness (IV5a)			0.06	0.00	0.03	0.00
Economic fitness (IV5b)			0.89	0.03	0.03	0.04
Institutional Environment (ModV)			0.09	0.00	0.02	0.00

*n=404, *=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001*

6.4.5.2 Moderated multiple regression analysis - Manipulation

In order to investigate how the sustainable farm dam management institutional environment affects the relationship between the independent variables and an actively resistant manipulation response, the results of a moderated multiple regression are presented in Table 6.31. With the inclusion of the interaction term there was no change in the predictive value of the model (F(17,368)=0.65, p>0.05). In fact, the inclusion of the interaction terms reduced the F-value for the model, although it remained highly significant (F(17,368)=11.17, p<0.001). This suggests that the overall relationship between institutional pressures and a very active sustainable farm dam management response is not moderated by the strength or integration of the institutional environment.

Table 6.31 - Moderated multiple regression analysis – Manipulation

Variable	R^2 (%)	$R^2\Delta$	*F*	*t*	*b*	*SE b*	*β*
(Constant)	51.50	1.50	11.17***	1.51	0.52	0.35	
Environmental uncertainty* Institutional Environment				-0.06	-0.00	0.03	-0.00
Inter-connectedness* Institutional Environment				0.68	0.02	0.03	0.03
Legal coercion-action * Institutional Environment				0.25	0.01	0.03	0.01
Legal coercion- threat * Institutional Environment				1.59	0.05	0.03	0.08
Voluntary diffusion* Institutional Environment				-0.44	-0.01	0.03	-0.02
Lack of decision making power* Institutional Environment				0.85	0.02	0.03	0.04
Inconsistency with goals* Institutional Environment				-0.28	-0.01	0.03	-0.01
Multiplicity* Institutional Environment				-0.30	-0.02	0.03	-0.02
Dependence on constituent* Institutional Environment				-0.59	-0.02	0.03	-0.02
Industry body pressures* Institutional Environment				0.15	0.00	0.03	0.01
Insurer pressures* Institutional Environment				-1.12	-0.03	0.03	-0.05
Bank pressures* Institutional Environment				1.46	0.04	0.03	0.07
Community group pressures* Institutional Environment				0.57	0.01	0.03	0.02
Environmental group pressures* Institutional Environment				0.04	0.00	0.02	0.00
Media pressures* Institutional Environment				0.65	0.02	0.03	0.03
Social fitness* Institutional Environment				-0.65	-0.02	0.03	-0.03
Economic fitness* Institutional Environment				-0.73	-0.02	0.03	-0.03

*n=404, *=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001*

The data presented in Table 6.31, the moderated model for manipulation, suggests that the institutional environment does not moderate any relationships for this dependent variable.

When this is investigated further with the multiple regression undertaken on a state-by-state basis, it can be seen that a pattern does emerge with the strength of the institutional environment, especially as it relates to community and environmental group involvement in sustainable farm dam management pressure. The state-based multiple regression analysis is presented in the following section.

6.4.5.3 State-based multiple regression analysis – Manipulation

The state-based multiple regression models were all significant predictors of manipulation. The combination of independent variables in South Australia predicted 56.40% of variance in manipulation ($F(17,82)=6.23$, $p>0.001$), 64.80% in NSW ($F(17,82)=9.10$, $p>0.001$), 48.60% in Victoria ($F(17,82)=4.66$, $p>0.001$), and 55.60% of variance in Tasmania ($F(17,82)=6.05$, $p>0.001$) (Table 6.32).

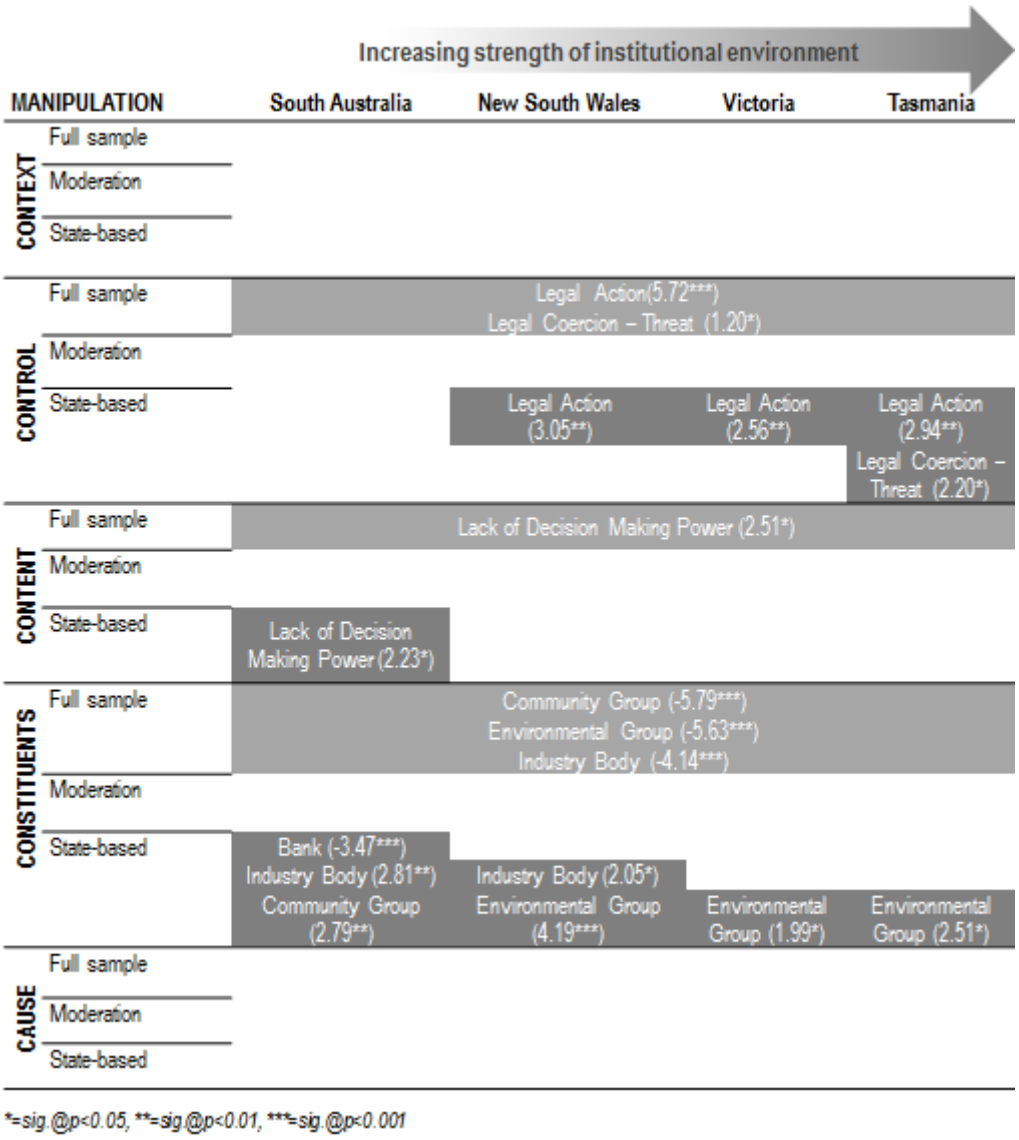
Table 6.32 – State-based multiple regression analysis – Manipulation

Test State	South Australia (*n*=100)						New South Wales (*n*=102)						Victoria (*n*=102)						Tasmania (*n*=100)					
Variable	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*	R^2 (%)	*F*	*t*	*b*	*SE b*	*β*
(Constant)	56.40	6.23***	4.25***	3.08	0.73		64.80	9.10***	-1.05	-0.69	0.66		48.60	4.66***	1.36	1.14	0.84		55.60	6.05***	0.46	0.37	0.81	
Environmental uncertainty (IV1a)			1.22	0.05	0.04	0.12			0.17	0.01	0.04	0.01			1.15	0.06	0.05	0.12			0.26	0.01	0.04	0.02
Inter-connectedness (IV1b)			-0.87	-0.07	0.08	-0.08			0.93	0.07	0.08	0.08			0.67	0.06	0.09	0.07			0.54	0.05	0.10	0.04
Legal coercion-action (IV2a(i) new)			1.63	0.14	0.09	0.15			3.05**	0.34	0.11	0.30			2.56**	0.24	0.09	0.26			2.94**	0.29	0.10	0.29
Legal coercion-threat (IV2a(ii) new)			0.21	0.01	0.07	0.03			0.22	0.02	0.08	0.02			-0.04	-0.00	0.09	-0.00			2.20*	0.19	0.09	0.23
Voluntary diffusion (IV2b)			-0.47	-0.05	0.10	-0.05			0.84	0.08	0.10	0.07			-0.47	-0.05	0.11	-0.05			-0.50	-0.05	0.09	-0.05
Lack of decision making power (IV3a)			2.23*	0.15	0.07	0.21			-0.23	-0.01	0.06	-0.02			1.32	0.11	0.08	0.14			1.33	0.15	0.08	0.19
Inconsistency with goals (IV3b)			-0.57	-0.03	0.05	-0.05			-1.03	-0.05	0.05	-0.08			-0.51	-0.03	0.06	-0.05			-1.09	-0.07	0.06	-0.12
Multiplicity (IV4a)			0.05	0.00	0.04	0.01			1.10	0.06	0.05	0.09			-0.89	-0.05	0.05	-0.09			-1.55	-0.08	0.05	-0.15
Dependence on constituent (IV4b)			0.75	0.04	0.06	0.06			1.11	0.56	0.05	0.10			-0.76	-0.05	0.07	-0.07			1.33	0.10	0.08	0.12
Industry pressures (IV4 Sub1)			2.81**	0.12	0.04	0.24			2.05*	0.10	0.05	0.18			1.50	0.09	0.06	0.14			1.31	0.09	0.07	0.12
Insurer pressures (IV4 Sub2)			0.75	0.05	0.06	0.06			0.44	0.03	0.06	0.03			-0.22	-0.02	0.08	-0.02			-1.24	-0.08	0.06	-0.11
Bank pressures (IV4 Sub3)			-3.47***	-0.27	0.08	-0.28			0.62	0.05	0.09	0.06			-0.53	-0.05	0.09	-0.05			0.42	0.02	0.05	0.04
Community group pressures (IV4 Sub4)			2.79**	0.11	0.04	0.14			0.81	0.04	0.05	0.07			3.36***	0.19	0.06	0.31			2.82**	0.14	0.05	0.25
Environmental group pressures (IV4 Sub5)			1.64	0.07	0.04	0.14			4.19***	0.26	0.06	0.36			1.99*	0.11	0.06	0.17			2.51*	0.14	0.06	0.22
Media pressures (IV4 Sub 6)			-1.28	-0.10	0.07	-0.10			-0.27	-0.03	0.11	-0.03			1.20	0.10	0.09	0.10			0.14	0.02	0.13	0.01
Social fitness (IV5a)			1.04	0.05	0.05	0.09			-0.33	-0.02	0.05	-0.03			-0.63	-0.05	0.07	-0.06			-0.51	-0.03	0.06	-0.05
Economic fitness (IV5b)			0.96	0.05	0.05	0.80			0.92	0.06	0.06	0.08			1.37	0.10	0.08	0.15			-0.66	-0.04	0.06	-0.06

=sig.@p<0.05, **=sig.@p<0.01, *=sig.@p<0.001*

In the main, the relationships that emerge from the state-based comparison support the results from the multiple regression of the full sample. The two differences that must be noted are: community and environmental groups' involvement in sustainable farm dam management pressure become strong *positive* predictors of a manipulation response – particularly community groups in the weak, South Australian farm dam institutional environment (β =0.14, t (100) =2.79, p<0.01), and environment groups in increasingly strong environments (NSW: β =0.36, t (102) =4.19, p<0.001; VIC: β =0.17, t (102) =1.99, p<0.05; TAS: β =0.22, t (100) =2.51, p<0.05); and, the strong dependence predictor of high resistance evidenced in the full sample multiple regression, is not apparent in any single state in the state-based multiple regression analysis. In the full sample, the involvement of groups and professional bodies was negative. In the moderated model these coefficients, although not significant, returned to positive with the inclusion of the moderating variable of farm dam institutional environment, indicating the potential for these relationships to be effected by the institutional environments. Figure 6.17 demonstrates these anomalies and the similarities between the full sample, and state-based tests visually. These results and the results for the other dependent variable multiple regression models will be discussed further in the following chapter.

Figure 6.17 – Summary of results of statistical tests for the manipulation model



*=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001

6.5 Summary

This chapter contained analysis of the items used to measure the variables in order to create valid and reliable scales for hypotheses testing. The multiple regression analyses have shown that from the five models of dependent variables tested, the independent variables significantly predicted variability of response to sustainable farm dam management pressure in all of the models. The moderating effect of the sustainable farm dam management institutional environment does not create a significant R^2 change for any dependent variable model however there were significant interaction effects of interest that will be considered further in the discussion. The state-based multiple regression analyses

enable cross-checking of the moderated multiple regression models and a deeper analysis on a state-by-state basis.

Overall, the results contribute to a solution for Research Problem 3 by providing improved understanding of the relationship between farmers' perceptions of sustainable farm dam management in relation to the institutional environment. The results indicate statistically how the farmers' perceptions of sustainable farm dam management are related to the institutional environment and the potential for their resistance to surface water storage pressures.

The farmers did not always respond as predicted in the hypothesising contained in Chapter 4. Farmers did strongly resist elements of the perceived context (IV1), control (IV2), constituents (IV4), and cause (IV5) of institutional pressures from their environment. However, lower levels of resistance to sustainable farm dam management institutional pressures were also likely in the face of various elements of context (IV1), control (IV2), and constituents (IV4). The main overarching variables that separated higher and lower levels of farmer resistance were the content (IV3) and the cause (IV5) of the pressures.

From the analyses presented it appears that dependence on government, voluntary diffusion of practice, interconnectedness with other farmers in the field, economic and social fitness resulting from sustainable management, and involvement from non-regulatory key actors in the institutional field, can all facilitate low resistance to sustainable farm dam management pressure. The highest resistance will be predicted by the threat of legal action and interference by environmental groups. These relationships, and the others discovered, will be elaborated on further in the following chapter.

Limitations of the data analysis include the cross-sectional nature of the data and the fact that all of the data is based on perceptions, with the exception of the moderating variable, institutional environment, which was a ranking devised from review of institutional systems in Chapter 3. In addition, the existence of lower-range Cronbach's Alpha scores (for example, for the Context-Interconnectedness measure, Section 6.3.3.7) can be problematic. Although every effort was made to minimise the limitations of the Interconnectedness measure, the implications of reliance on this measure will be discussed further in Chapter 7. The final chapter, Chapter 8, addresses these limitations as part of the discussion of the contribution of this study to theory and practice, and also the limitations of the study more broadly. Firstly, discussion of results presented follows in Chapter 7 in order to elaborate on the statistics contained in this chapter.

Chapter 7

Responses to sustainable farm dam management pressures from the institutional environment

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7.1 Introduction

The main aim of the research is to address the overarching research problem of a lack of understanding of the relationship between sustainable farm dam management pressures from the institutional environment, and the farmers' resistance to these pressures. The institutional environment was reviewed (Chapter 3) and a model based on Oliver's (1991) framework of institutional and resource dependence theories was proposed. As a result, sixteen main hypotheses were developed (Chapter 4) for testing in four strengths of sustainable farm dam management institutional environment (Chapter 5). The results (Chapter 6) find support for various elements of Oliver's (1991) conceptual model and preliminary findings confirm the importance of the farmer as an actor in the successful acceptance and adoption of institutional pressure to manage dams sustainably. This chapter now seeks not only to explore the results from Chapter 6 against the 17 hypotheses in more depth, but also to amalgamate the addressing of the research problems and sub-research questions in the thesis.

The chapter proceeds as follows: firstly, the overarching findings of the study will be discussed in relation to the three elements of the research problem explored by this study. Secondly, the empirical findings will be discussed in detail addressing each hypothesis and its acceptance or rejection. Thirdly, the overarching meaning of the findings will be deliberated, allowing for narrowing down to critical key findings that emerge in the context of comparative studies. Fourthly, implications of the study for theory and for practice will be considered, and sustainable farm dam management guidelines established, based on key findings, that provide the best chance of reducing resistance to sustainable farm dam management pressure. Lastly, strengths and weaknesses of the study will be addressed.

7.2 Overarching findings of the study in relation to the research problems

This discussion addresses each element of the research problem and associated sub-research questions in order to contribute to the overarching findings of the study that will be narrowed to key findings of the results in later sections. The discussion following will address each element of the main research problem in turn.

7.2.1 Discussion of Research Problem 1: A lack of understanding of the equity and safety mechanisms in the institutional environment of farmers managing farm dams

Chapter 3 provided a review of the contextual setting of the study in order to answer sub-Research Question 1: *What are the equity and safety mechanisms in the institutional environment of farmers managing farm dams?* A review of the sustainable farm dam management environment in Australia was undertaken which provided a map of the formal and informal equity and safety mechanisms in place. The analysis of the four components of content and integration, accountability monitoring, accountability for small dams, and reporting mechanisms, enabled four test states for the study focus to emerge that provided the setting for the empirical study.

The review of the states found Tasmania to be a 'very strong' sustainable farm dam management institutional environment. South Australia, with no safety mechanisms at all, provides a 'weak' measure of the sustainable farm dam management institutional environment. In the middle of the trend toward increasing strength of institutional environment, New South Wales represents a 'moderate' strength environment with strong equity and strong safety mechanisms but no integration of them and, Victoria, with less strong than in Tasmania, but well-integrated equity and safety elements, represents a 'strong' institutional environment.

The outcome of the review is improved understanding and context of the institutional environment of sustainable farm dam management in Australia and facilitation of selection of four states that represent the maximum variation in policy strength and integration of equity and safety mechanisms for inclusion in empirical modelling. Therefore, the overarching finding for improving knowledge of Research Problem 1 is:

A continuum of four strengths of sustainable farm dam management institutional environment and understanding of their elements (Chapter 5, Figure 5.2)

7.2.2 Discussion of Research Problem 2: A lack of understanding of the institutional pressures that can cause a sustainable farm dam management response from farmers

In order to improve understanding of farmer resistance to sustainable farm dam management pressure from the institutional environment, the pressures that can cause a response from farmers require attention and so sub-research question 2 asks*: What are the institutional pressures that can cause a sustainable farm dam management response from farmers?*

The review in Chapter 4 of the dual institutional and resource dependence theoretical framework and Oliver's (1991) strategic response typology facilitated understanding of the institutional pressures and the potential for farmer resistance to them. Five overarching institutional pressures that can cause a sustainable farm dam management response emerged from the review. Elements of context, control, content, constituents, and cause all were explored for understanding and ultimately hypothesised to predict a response from farmers. Under the framework, these strategic responses are five levels of resistance ranging on a spectrum from low resistance to institutional pressure to high resistance to institutional pressure. The responses of acquiescence, compromise, avoidance, defiance, and manipulation were all possible outcomes in the model for empirical testing in the sustainable farm dam management context. Therefore, the overarching finding for improving knowledge of Research Problem 2 is:

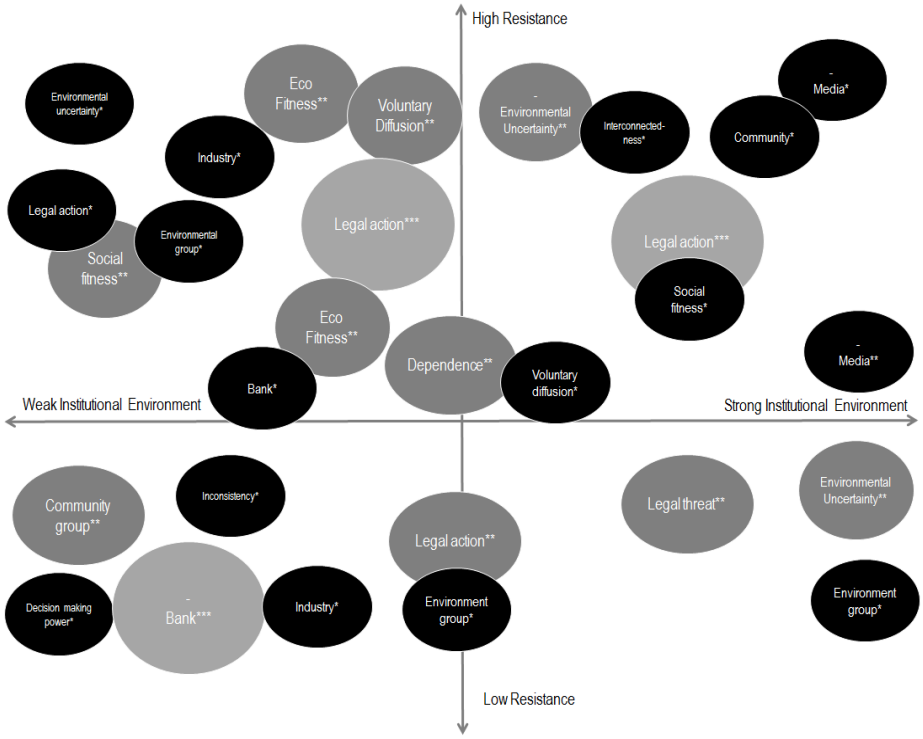
Five possible institutional pressures from the sustainable farm dam management environment and five possible responses from farmers (Chapter 4, Figure 4.1)

7.2.3 Discussion of Research Problem 3: A lack of understanding of the relationship between farmers' perceptions of sustainable farm dam management in relation to the institutional environment and the potential for farmer resistance to the surface water storage pressures

The investigation for developing knowledge of the farm dam management pressure-response relationships identified in Research Problem 3 was advanced through the analysis of results in Chapter 6. The empirical investigation of farmer perceptions through a quantitative survey facilitated improved understanding of Research Problem 3, and contributed to solving the overarching research problem. In order to achieve this, the research asked the question: *How are the farmers' perceptions of sustainable farm dam management related to the institutional environment and the potential for farmer resistance*

to surface water storage pressures? Various relationships emerged from the empirical testing. Although there were several anomalous relationships, there was also support for much of the modelling undertaken in Chapter 4 that replicated and built upon Oliver's (1991) strategic response typology. Figure 7.1 provides a summary overview of the main patterns emerging from analysis of the sustainable farm dam management responses of farmers to the five institutional pressures from the four different environments.

Figure 7.1 - Mapping of predictor variables onto a matrix of levels of resistance to pressures and strength of institutional environment*



*The figure maps individual pressure results according to their effect size onto the matrix of the continuum of resistance to institutional pressure and strength of institutional environment. The size of each bubble increases in ascending order of significance of the regression coefficient (β). That is, the small black bubbles represent significant at $p<0.05$, the medium, grey bubbles, a significant result at $p<0.01$, and the large light grey bubbles, the greatest significance of $p<0.001$.

Therefore, the overarching finding for improving knowledge of Research Problem 3 is:

Prediction of farmers' five possible responses to perceptions of five institutional pressures in four different sustainable farm dam management environments (Figure 7.1)

Discussion of the above summarised results for each hypothesis predicting each institutional antecedent's effect on farmer resistance to sustainable dam management will be presented in the following section.

7.3 Discussion of the empirical findings

Each hypothesis presented in Chapter 4 was tested statistically and the results presented in Chapter 6. Table 7.1 provides a summary of the findings of the hypotheses testing and the results obtained from the moderated multiple regression, and state-based analyses.

Table 7.1 - Hypotheses testing

Hyp	Hypothesis	Result from full sample	Effect of strength of institutional environment	State-based effect
1a	↑Environmental uncertainty = ↓Resistance	**UNSUPPORTED** ↑Environmental uncertainty = ↑Resistance	**MOD** ↑Environmental uncertainty + ↑Institutional environment= ↓Resistance	**SA** ↑Environmental uncertainty = ↓Resistance **VIC** ↓Environmental uncertainty = ↓Resistance **TAS** ↑Environmental uncertainty = ↑Resistance
1b	↑Interconnectedness = ↓Resistance	**SUPPORTED**	No effect	**VIC** ↑Interconnectedness = ↓Resistance
2a(i) new	↑Legal coercion *action* = ↓Resistance	**SUPPORTED** (but also ↑Legal coercion *action* = ↑ Resistance)	No effect	**NSW, VIC, TAS** ↑Legal coercion *action* = ↑↑Resistance
2a(ii) new	↑Legal coercion *threat* = ↓Resistance	**UNSUPPORTED** ↑Legal coercion *threat* = ↑Resistance	No effect	**VIC, TAS** ↑Legal coercion *threat* = ↑↑Resistance
2b	↑Voluntary diffusion = ↓Resistance	**SUPPORTED**	No effect	**NSW** ↑Voluntary diffusion = ↓↓Resistance **VIC** ↓Voluntary diffusion = avoidance
3a	↑Lack of decision making power = ↑Resistance	**SUPPORTED** (but also ↑Lack of decision making power = ↓ Resistance)	No effect	**SA** ↑Lack of decision making power = ↑Resistance **VIC** ↑Lack of decision making power = ↓ Resistance
3b	↑Inconsistency with goals = ↑Resistance	**SUPPORTED**	No effect	**SA, NSW** ↑Inconsistency with goals = ↑Resistance
4a	↑Multiplicity = ↑Resistance	Not significant	No effect	No effect
4b	↑Dependence = ↓Resistance	**UNSUPPORTED** (↑Dependence =avoidance)	No effect	All states significant
4 Sub1	↑Industry pressure = ↓Resistance	**SUPPORTED**	No effect	**SA, NSW** ↑Industry pressure = ↓Resistance
4 Sub2	↑Insurance pressure = ↓Resistance	Not significant	No effect	No effect
4 Sub3	↑Bank pressure = ↓Resistance	**SUPPORTED** (in reverse ↓Bank pressure = ↑Resistance	**MOD** ↓Bank pressure +↑Institutional environment= ↑Resistance	**SA** ↓Bank pressure ↑Resistance
4 Sub4	↑Community group pressure = ↓Resistance	**SUPPORTED**	No effect	**TAS** ↑Community group pressure = ↓Resistance **SA** ↑Community group pressure = ↑Resistance
4 Sub5	↑Environmental group pressure = ↓Resistance	**UNSUPPORTED** ↑Environmental group pressure = ↑Resistance	No effect	**NSW, VIC, TAS** ↑Environmental group pressure = ↑Resistance
4 Sub6	↑Media pressure = ↓Resistance	**UNSUPPORTED** (↑Media pressure=avoidance)	**MOD** ↓Media pressure+ ↑Institutional environment= ↓Resistance	**NSW, TAS** ↑Media pressure= avoidance
5a	↑Social fitness = ↓Resistance	**SUPPORTED**	No effect	All states
5b	↑Economic fitness = ↓Resistance	**SUPPORTED**	No effect	All states

The following sections discuss the empirical results of the hypothesis testing in more detail.

7.3.1 Hypotheses 1: Context (IV1)

The *uncertainty of the environment* and the *interconnectedness* of farmers within that environment, is the context for sustainable farm management pressure, and can shape an organisation's strategic response. Environmental uncertainty is defined as 'the degree to which future states of the world cannot be anticipated and accurately predicted' (Pfeffer & Salancik, 1978, p.67). Interconnectedness refers to the 'density of interorganisational relations among occupants of an organizational field' (Oliver, 1991, p.170). Therefore, the first set of hypotheses were designed to investigate whether resistance to sustainable farm dam management pressures is greater when farmers are operating in increasingly uncertain environments and there are not strong connections in the institutional field. Testing of the two context sub-hypotheses is summarised as follows.

- **Unsupported Hypothesis 1a: Environmental uncertainty**

It was hypothesised that when high levels of uncertainty exist in the environment, farmers will be motivated to attempt to reduce the uncertainty by acquiescing to institutional pressures. For example, during periods of extreme flood events and high water storage risk, farmers may be more willing to comply with the demands imposed upon them by an institutional actor. However, the results of the study do not support the hypothesis and suggest that farmers are in fact more likely to actively resist sustainable farm dam management pressures if the context of the pressure is highly uncertain.

The strategy predicted to be employed to resist the pressure is defiance in the form of public resistance to pressures. This active resistance involves an overt response that occurs usually when the comprehension of the pressure is low or the motives behind it incomprehensible to the farmer, or the farmer believes the situation is best managed using usual, unsustainable behaviours. This finding suggests that uncertainty creates confusion or motivation to defy the pressure to manage farm dams sustainably.

Furthermore, environmental uncertainty as a predictor of strong resistance to sustainable farm dam management pressure is moderated by the strength of the institutional environment. Specifically, the stronger, more well-integrated the institutional environment of the farmer, the less likely it will be that the environment is uncertain and thus low environmental uncertainty predicts a passive acquiescent farmer response to pressure. For example, in times of water insecurity in drought, or structural uncertainty in times of flood,

having a strong institutional support structure in the form of well-integrated policy can provide farmers with information, data and support that assists their planning and subsequent passivity to pressure to manage dams sustainably. Such a setting is evidenced in the state-based results in Victoria, where the institutional environment is strong and well-integrated.

In South Australia, where the institutional environment is weak, high environmental uncertainty is a significant predictor of an acquiescent response. This is the opposite result of that realised in the strong institutional environments and full sample, and is the result that was originally hypothesised. The result in South Australia lends support to the possibility that farmers' knowledge that institutional actors are not aware of, or active on, the issues surrounding sustainable farm dams creates more insecurity in times of uncertainty such as drought or flood, and subsequent passivity to any pressures (emergency or otherwise) to manage dams sustainably.

- **Supported Hypothesis 1b: Interconnectedness (IV1b)**

Farmers are more likely to accede to the pressures of the institutional environment when the environment is highly interconnected thereby facilitating the voluntary diffusion of norms, values, and shared farm dam information. Because highly interconnected environments provide channels through which institutional norms can travel, there could be a tendency for coordination and collectivisation to advance and thus less resistance to institutional pressure. It was hypothesised that farmers would be more likely to accept and acquiesce to institutional farm dam management pressures if their regional environment was highly connected and good farm dam practice was a shared value between farmers.

This hypothesis was supported and a highly interconnected farm dam management environment is a predictor of a passive response to sustainable farm dam management pressures. The most likely response is acquiescence which is usually in the form of taken for granted obedience of farm dam institutional rules and norms, or mimicry of best practice in the region or industry. An example of this is sustainable farm dam management practice that is a shared value amongst close regional/industry alliances, such as a series of wineries in a grape-growing region, or a visible cumulative scenario between neighbours in a catchment. The state-based results suggest that this interconnectedness is the case especially in Victoria.

The collectiveness created by alliances generates increased certainty in order for farmers to operate without fear of not getting their fair share of water or dangerous sudden flooding caused by dam failure. Farmers are subsequently less resistant to pressure to manage farm dams sustainably. This relationship is independent of the institutional environment in which the farm dam management pressures are occurring, indicating even in a weak, poorly connected institutional environment, interconnectedness amongst farmers in a community is critical to the success of sustainable farm dam management.

7.3.2 Hypotheses 2: Control (IV2)

Control is a very important variable in the investigation of sustainable farm dam management. Control in the farm dam institutional environment refers to the means by which institutional pressures are imposed on farmers whether they be through the threat of legal coercion, legal action or by diffusion of a practice without legal involvement. It was hypothesised that the stronger the legal coercion and well-diffused the practice, the less likely farmers would be to resist the pressure. This variable has a strong regulatory aspect because of the prescriptive nature of regulation which can be a powerful force in a farmer's institutional environment. The results of testing of the two sub-hypotheses will be discussed further in the following paragraphs.

- **Supported Hypothesis 2a(i): Legal coercion action**

It was initially hypothesised that the force of institutional influences such as explicit government regulation through legal coercion would be likely to predict a passive response of farmers to pressures to manage their farm dams sustainably. The theoretical basis is that farmers would be more aware of threats of noncompliance with farm dam sustainability regulations and the resulting fear of economic losses and losses of legitimacy would cause them to acquiesce to pressure. Statistical validity analysis of the items designed to measure legal coercion resulted in two distinct elements of coercion emerging – (i) *action*, such as actual field officer inspection of dam capacity or spillway safety, and (ii) the more general *threat* of legal coercion, such as the fear of fines.

The 'action' of legal coercion, such as mandated regular inspection and supervision of spillways or dams, was hypothesised to be met by farmers with low resistance unless the requirements were not well enforced and then escalation toward a more active response would be usual. The results supported this hypothesis, finding that the low resistance

strategy of compromising to pressure was strongly predicted by legal coercion action in all settings.

However, legal coercion action was also strongly predictive of a highly resistant manipulation of pressure response. This was investigated further by state-based results that suggest in environments of increasing strength of farm dam institutional environment, farmers will strongly resist legal coercion action. That is, in New South Wales, Victoria and Tasmania the reality of sustainable farm dam legal action pressure, particularly safety pressure in all three states, is 'real' and apparent, and thus more readily manipulated than somewhere like South Australia, where there is not as much strength of farm dam management institutional environment, especially as it relates to safety legal coercion action.

- **Unsupported Hypothesis 2a(ii): Legal coercion threat**

The more general 'threat' of legal coercion represents the overarching farmers' perception of fear of regulation more abstractly. It was hypothesised, under the umbrella of legal coercion, that the regulatory threat to manage farm dams sustainably would be met with a passive response from farmers. This hypothesis was unsupported because the threat of legal coercion was in fact strongly resisted by defiance, and even manipulation.

The state-based results highlight that a defiant response to the legal threat of sustainable dam management was likely to be assumed by farmers in Victoria and Tasmania, with farmers in Tasmania also endeavouring to manipulate the threat of legal coercion. Similar to the above discussion of the results for legal coercion action, the results here highlight that in a strong institutional environment, the threat is more real and understood and subsequently, more likely to be resisted than somewhere where there is less real possibility of legal action pressure from the sustainable farm dam management institutional environment.

- **Supported Hypothesis 2b: Voluntary diffusion (IV2b)**

It was hypothesised that the extent to which a regulated practice is diffused or spread throughout a farming network will predict the success with which the farmer strategically responds to pressure to manage dams sustainably. The power of voluntary diffusion of sustainable farm dam management practice throughout a system is that the practice, and associated behaviour and norms, are likely to become taken for granted assumptions in

the institutional environment of the farmer. Pressure from the institutional environment to manage dams sustainably is then usually complied with. The results suggest that if sustainable farm dam management practice is well-diffused voluntarily throughout a region or industry then pressure to manage sustainably is likely to result in a passive, low resistant, acquiescent response, as hypothesised.

State-based results suggest this low resistance to pressure if practice is voluntarily diffused is especially apparent in New South Wales. Also significant, especially in Victoria, is that if voluntary diffusion of sustainable farm dam management is reduced in an institutional environment, then any pressure to manage that way is likely to be avoided by farmers. Avoidance of farm dam management pressures can manifest in the concealment of bad practice or the buffering of pressures.

7.3.3 Hypotheses 3: Content (IV3)

The content of the actual institutional pressure to manage farm dams sustainably will be critical to predicting positive outcomes for sustainable farm dams. The demands of external constituents can often conflict with the internal logic of farming production with the result that farmers will tend to buffer themselves from the outside influence. It was hypothesised that resistance to sustainable farm dam management pressure will arise if the content limits farmer decision making discretion or if it is inconsistent with farmer goals.

- **Supported Hypothesis 3a: Lack of decision making power (IV3a)**

The removal of farmer dam decision making power was logically hypothesised to be viewed very negatively by farmers resulting in resistance to the demands of external institutions. Farmers would be expected to exhibit low resistance to pressure if they retain decision making power about their surface water storage activities and this was supported by the results of the study. The study finds a lack of farmer decision making power predicts a strong manipulation resistance response to sustainable farm dam management pressure. State based results identify this predictive relationship of decision making power and manipulation of pressure as strong in South Australia, a weak sustainable farm dam institutional environment.

However, further results for decision making power are somewhat anomalous. Lack of decision making power also predicted a low resistance to pressure. The state based results indicate that this is localised to Victoria where it is possible that having sustainable

farm dam management decisions made by the more local and involved rural water corporations (see Chapter 3) means that pressures to manage dams sustainably will be met with little resistance. The successful acceptance of farm dam management pressure resulting from the removal of the decision making power of farmers in Victoria could indicate that farmers require increased guidance and decisions making facilitation in times of water storage stress.

- **Supported Hypothesis 3b: Inconsistency with goals (IV3b)**

It was also hypothesised that if inconsistency exists between a farmer's goals for water storage and institutional pressure drivers, then resistance to pressure to manage dams sustainably will exist. This resistance will usually be in the form of superficial changes to management practice or open defiance of the pressure to conform. This proposition was supported by the results of the study which suggest that if standards placed on practice are not consistent with farmers' internal operations and procedures then the farmer will actively resist them in the form of defiance.

The state-based results reveal that this relationship of inconsistency of farmer goals and defiance is strong in South Australia and New South Wales, which are both weak institutional environments compared to Victoria and Tasmania. Potentially this could connote that pressures in those locations, such as those from regulations and standards, are not as well-developed so any attempts to place pressure on farmers will be defied more readily than in states where the pressures are more established and coherent in the sustainable farm dam management institutional environment of farmers.

7.3.4 Hypotheses 4: Constituents (IV4)

The farmer's institutional field is made up of many constituents that can force sustainable farm dam management pressure upon the farmer. Often, the pressure can be inconsistent and conflicting and the relationships to the pressure sources varied in strength. Individual pressure sources can also be powerful and include farming industry bodies, insurance and finance providers, community and environmental groups, and the media. Each of the hypotheses related to constituents will be discussed in turn.

- **Unsupported Hypothesis 4a: Multiplicity (IV4a)**

The study hypothesised that multiple constituents with conflicting sustainable farm dam management demands could create fragmentation in the farmer's institutional field and this

lack of consensus and multiplicity of constituents could result in reduced compliance with institutional pressures. However the study found that multiplicity was not a significant predictor of any type of response to sustainable farm dam management pressure measured.

- **Unsupported Hypothesis 4b: External dependence (IV4b)**

It was also hypothesised that increasing dependence on external pressure sources for sustainable farm dam management was likely to result in reduced resistance to pressure. This assumption is based on the theoretical postulation that external parties have an element of control over the allocation of critical farmer resources. If a farmer is dependent on a constituent in the field of sustainable farm dam management, particularly government as this variable assumes, then they would be less likely to resist their demands to manage dams sustainably. However this study found that increasing dependence on government pressure sources was met with a sustainable farm dam management avoidance strategy. The results indicate that dependence on government may be less important for farmers than for example, agricultural supply chain legitimacy afforded by a farming industry body, or community group approval to encourage acceptance of farm dam management guidance and regulation. This result was significant across all states.

This study went beyond Oliver's (1991) conceptual model of constituents which consisted of only variables of multiplicity and external dependence, to measure the effects of selected constituents in the institutional field of the farmer who are able to exert or influence pressure to manage dams sustainably.

- **Supported Hypothesis 4 Sub1: Industry body involvement (IV4 Sub1)**

Farming industry bodies can be a powerful force in many farmers' institutional fields. Industry bodies have the power to assist farmers in influencing farm dam management standard setting and ensure standards and guidelines are developed with the farmers' best interests in mind. The study hypothesised that if farming industry bodies were involved in sustainable farm dam management issues, it would reduce resistance to pressure to manage farm dams sustainably. In support of this hypothesis, this study found that increased involvement by industry bodies in sustainable farm dam management was met with acquiescence to pressures to manage dams a certain way.

The state-based results suggest the relationship between industry bodies and low resistance to dam management pressure is more significant in South Australia and New

South Wales. These two states represent the weak range of sustainable farm dam management institutional environment, and thus there is the potential that involvement from industry bodies is greater in these locations. Because new institutional forces are emerging in weak environments, more industry representation to facilitate reduction of farmer resistance and comprehension and cohesiveness of pressures is required[9].

- **Unsupported Hypotheses 4 Sub2 and Sub3: Insurance and banking involvement (IV4 Sub2 and Sub3)**

As natural disasters become more frequent and social and environmental performance influences farming business risk, banks and insurers are becoming increasingly involved in sustainable management strategies. Banks may consider writing caveats into their loan agreements regarding any dangerous or potentially hazardous assets or insurers could also refuse to insure a farmer undertaking unsafe water storage management practice on the farm.

It was hypothesised that insurance industry involvement in farm dam management would predict a passive response to pressure to manage dams sustainably, however the study found no significant result. For bank involvement farm dam management, the study found that lower pressure from banks and financial institutions was predictive of avoidance of sustainable dam management in strong institutional environments. That is, in states with strong institutional environments, farmers would be likely to avoid pressure to manage dams sustainably. For example, in Victoria or Tasmania, if the farmer's bank was *not* involved in sustainable dam management then common strategies in response to pressure would be to conceal or buffer undesirable parts of organisational activities from institutional pressures to manage dams sustainably.

Interestingly, the state-based results suggest that farmers in the weak institutional environment of South Australia are more likely to manipulate sustainable farm dam management pressure if banks are involved in the institutional environment. This strong resistance to banking industry involvement in farm dam management in a weak institutional environment could mean that the lack of substance and clarity of sustainable dam management institutions makes incomprehensible any consideration of changing water storage practice for financial providers. Whereas, in strong institutional environments, some knowledge, and even rigour of sustainable water storage practice makes a financial

[9] The review of the institutional environment in Chapter 3 supports this notion, highlighting that South Australia's farming representative body has been vocal recently as the high concentration Mount Lofty Ranges endeavours to introduce a strict farm dam equity mechanism (see Chapter 3, Section 3.4.5).

body or bank asking for farm dam information, not seem so extraneous. The pressure to manage dams sustainably might then still be avoided, but not manipulated as inferred for the South Australian sample. This result highlights the significance of banks and finance providers in the institutional environment of farmers which has implications for the institutional field of promoting good dam management practice.

- **Supported Hypothesis 4 Sub4: Community group involvement (IV4 Sub4)**

The study purports that farmers will be more likely to manage their water storage sustainably if independent parties mobilise to change bad behaviour. This could be in the form of community or environmental group involvement. Community groups have the benefit of raising issues of importance and encouraging connectedness through farmers being 'good neighbours' in such a way that they do not want to be noticed for bad behaviour, like deliberately or negligently blocking their spillway. Community group involvement in farm dam management is hypothesised to be predictive of low resistance to institutional pressure for sustainable dam management.

The study finds that community group involvement in sustainable farm dam management can encourage a low resistant, acquiescent response to pressure to manage dams a certain way. The state-based results provide support of community group involvement in Tasmania, a very strong sustainable farm dam management institutional environment.

However, in South Australia, a weak farm dam institutional environment, strong resistance was found to community group involvement in sustainable management pressure. This result implies that community group involvement in sustainable farm dam management can result in low resistance to pressure in environments where sustainable farm dam management practice is already established through policy or other institutional mechanisms. In weak institutional environments, community group involvement predicts high resistance which could indicate that community awareness of the issues surrounding dam management is increased in strong institutional environments. On this basis, the pressure and involvement from community groups is not unexpected as it would be in a weaker institutional environment, like South Australia. In a strong institutional environment, community groups, through education and information, could align farmer interests with those of the pressure source or placate the pressure source so it is not perceived as offensive or manipulable to the farmer and their primary interests are not threatened.

- **Unsupported Hypothesis 4 Sub5: Environmental group involvement (IV4 Sub5)**

The study similarly hypothesises that in institutional environments where environmental groups have an interest in farm dam management, farmers are likely to be less resistant to pressure to manage farm dams for environmental sustainability in order to avoid negative attention in the form of protests or lobbying.

The study does find that a compromise response is possible for the full sample when faced with environmental group involvement in sustainable farm dam management, however the state-based results do not support this hypothesis. Instead, in New South Wales, Victoria and Tasmania, results find that environmental group involvement in sustainable farm dam management issues is related to increasing resistance to institutional farm dam management pressure. In these states, that represent moderate to very strong institutional environments, it is possible that farmers are resistant to the involvement of environmental groups as they have focused on particular agendas, such as environmental low flows[10], and have contributed to pressures that are completely removed from the goals of the farm. Environmental groups could be joining boards to influence and manipulate regulations or attempting to contribute strongly to standard setting processes. In the weaker institutional environments, these involvements are potentially less-well developed because of weaker institutional regulatory frameworks to work within.

- **Unsupported Hypothesis 4 Sub6: Media involvement (IV4 Sub6)**

The final individual constituent result is the media. The media plays an important role as an advocate for the environment and communities, and by shaping social norms as they relate to sustainability. The study hypothesises that concern over negative media attention and bad publicity about farm dams resulting in losses of legitimacy, will be predictive of reduced resistance to sustainable farm dam management pressure.

The results indicate that increased involvement by the media in sustainable rural water storage is predictive of avoidance of sustainable farm dam management pressure. That is, the more media attention the problems are given, the more likely the farmer will be to loosely couple with good practice by buffering pressure or concealing bad management practice and avoiding the pressure. The state-based results suggest this is increasingly the

[10] Diversion of stream flows into dams and storages interrupts the natural flow regime in a catchment and has noticeable impacts in times of low flow where the native fauna and flora that depended on the flow are unable to receive adequate water for feeding and breeding patterns (Thoms *et al*. 2000; Schreider *et al.,* 2002; Lee, 2003).

case in New South Wales and Tasmania, both states with strong safety mechanisms in their farm dam institutional environments, where perhaps media attention has been directed to floods from dam failure and resulting catastrophe.

However, the results also find that in a strong and well-integrated institutional environment, reduced attention from the media predicts an acquiescent or very passive response to sustainable farm dam management pressure. This suggests that when media attention is given to an issue such as farm dam management in an already strong institutional environment, the interest could cause unrest and insecurity, and potentially predict an increasingly resistant response.

7.3.5 Hypotheses 5: Cause (IV5)

The factors that lead to sustainable farm dam management that relate to the underlying motives for compliance with institutional pressures relate to 'cause'. If farmers doubt the social or economic benefits resulting from conformity to the pressure and the perception that institutional objectives or cause of the pressure are at cross purposes with their social and economic interests, then imposition of the pressure will be met with resistance.

- **Supported Hypothesis 5a: Social Fitness (IV5a)**

It is hypothesised that if a farmer believes that compliance with sustainable farm dam management rules or norms will enhance their legitimacy within their social environment, or 'social fitness' then they will be less likely to be resistant to pressure to manage dams sustainably. The study finds that increased perceptions of social fitness resulting from managing farm dams sustainably does predict low resistance to pressure in all states. The perceived increases in social fitness that can result from managing dams sustainably predict an acquiescent and also a compromise response. A compromise strategy, although less passive than acquiescence, involves elements of promotion of self-interest; however this reflects the nature of social fitness and thus the hypothesis remains supported. This result suggests that if socially detrimental activities take place, such as neighbours observing spillway blocking, the perceptions of losses of legitimacy are highly undesirable and this pressure will not be resisted, independent of institutional environment.

- **Supported Hypothesis 5b: Economic Fitness (IV5b)**

Unhealthy financial conditions or economic 'unfitness' can generate motivation to undertake socially or environmentally detrimental behaviour. The study hypothesises that

reduced economic fitness can be a predictor of increasing resistance and farmer negligence or deliberate bad behaviour because of unavailability of funds to undertake dam works such as spillway upgrades or maintenance. This hypothesis is supported by the results of the study that find that if farmers are economically fit, as it relates to sustainable farm dam management, then they will be acquiescent to pressure. State-based results support this finding, specifically economic fitness of New South Wales farmers as it relates to farm dams is a significant predictor of an acquiescent response. This finding in New South Wales could reflect the fear of fines that exists in an institutional environment containing strong dam safety mechanisms.

The above sections all contribute toward knowledge of the overarching research problem: the need to understand the relationship between sustainable farm dam management pressures from the institutional environment and the farmers' resistance to these pressures. The thesis now proceeds with discussion of the overarching meaning of the findings, including development of key findings by placing the results in the context of two related studies.

7.4 Meaning of the findings

It has been established in the thesis that the sustainable management of farm dams is a problem of critical real-world, and research importance. Farm dams are essential infrastructure for agriculture. Their unsustainable management can have catastrophic social, environmental and economic consequences should they be unfairly and unsafely storing more water than entitled to. In order to address this real-world problem, the overarching research question that the study endeavours to answer is: *How do farmers respond to institutional pressures to manage farm dams sustainably to achieve equity between stakeholders seeking this limited surface water resource and the safety of communities?* Therefore the meaning of the findings for the full sample as they relate to this research question will be discussed in the following sections.

7.4.1 Overarching meaning of the findings

Farmers from the full sample responded in a way that facilitates understanding of the certain institutional antecedents that will generate high resistance to sustainable farm dam management pressure, whilst others will engender low resistance. Broadly, Figure 7.2 and 7.3 show that much of high and low resistance to drives for equity between stakeholders

and safety of communities from farm dams share common sources of pressure. The two main antecedent distinctions identified in the figure that differentiate high and low resistance to sustainable farm dam management pressure are 'cause' and 'content'. These two variables become important for determining the best chance of reducing resistance to sustainable farm dam management pressure. Low resistance will be predicted by the cause of the institutional pressure, that is, social and economic fitness, and high resistance will be predicted by content, that is, the consistency of pressure with the goals of the farm, and the reduction in decision making power caused by the pressure.

Figure 7.2 - Full sample predictors of *low* resistance*

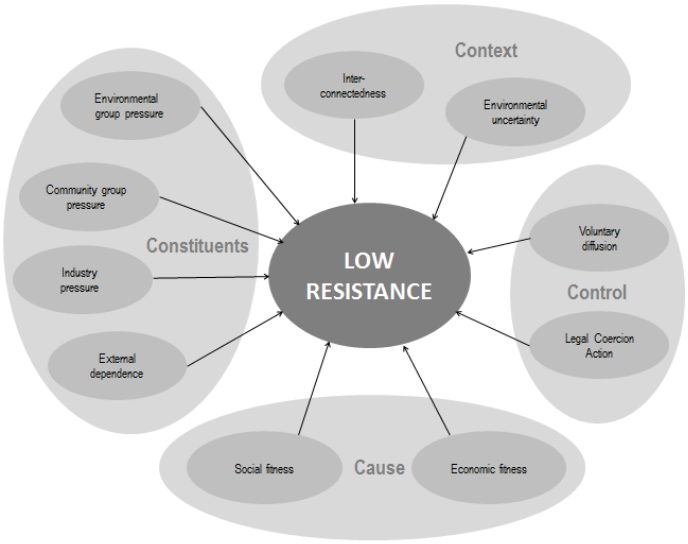
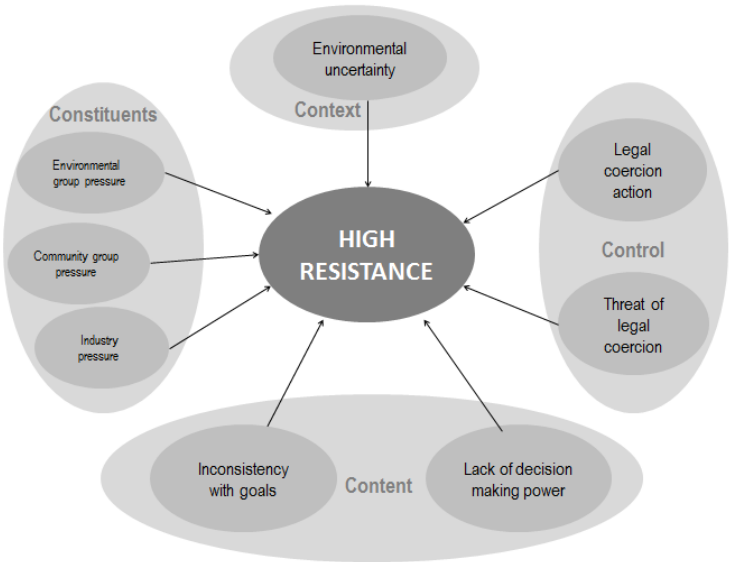


Figure 7.3 - Full sample predictors of *high* resistance*



*The figures map individual independent variables in dark grey within their light grey overarching variable groupings in order to provide visual demonstration of patterns emerging.

Overview of the full sample with a broad approach in this way enables comparison to be drawn to the first key study for framing the meaning of these results: Clemens and Douglas' (2005) analysis of institutional pressures and their resistance in the steel industry.

- **Understanding strategic responses to institutional pressures in the steel industry: Clemens and Douglas, 2005**

Clemens and Douglas' (2005) study adopted Oliver's dual institutional and resource dependence theoretical framework for analysis of the important real-world issue of radioactive contamination of scrap steel. As the first 'full test' of Oliver's (1991) model (Clemens and Douglas, 2005, p.1205), the authors garner manager perceptions for the measure of the five levels of resistance to institutional pressure as the dependent variables as per this study. However, the authors use objective measures for the five institutional antecedents of context, control, content, constituents, and cause. Because this thesis employs perceptions for all measures, drawing direct comparisons is challenging, however general relationships can be found as highlighted in Table 7.2 based on the full sample of this study. Viewing the results in this way allows for the emergence of patterns that the studies share.

Table 7.2 – Clemens and Douglas (2005) results from use of Oliver's (1991) model in the steel industry*

	CLEMENS AND DOUGLAS (2005)						THIS STUDY					
Pressure	**Sample size**	**Acquiescence**	**Compromise**	**Avoidance**	**Defiance**	**Manipulation**	**Sample size**	**Acquiescence**	**Compromise**	**Avoidance**	**Defiance**	**Manipulation**
Context	127	*			*		404	*			**	
Control		*	**					***	***	**	***	***
Content						**				*	***	*
Constituents		**	**			*			**	***		***
Cause								***	***			

* Because of the impossibility of paralleled direct comparison, the size of the regression coefficients is not captured, only the significance to determine any patterns. Figures are significance levels of regression coefficients, *=sig.@p<0.05, **=sig.@p<0.01, ***=sig.@p<0.001.

Although the studies are challenging to compare, it can be seen from the visual comparison of full sample multiple regression results, that principally, the same patterns emerge across both studies. If avoidance is not considered, this study's results parallel those of Clemens & Douglas' (2005) study providing a limited measure of cross-validation of the study. As a consequence of this comparison, the results from using Oliver's (1991) framework for understanding the relationship between farmers' perceptions of sustainable farm dam management and the potential for farmer resistance to the surface water storage pressures, allow the author to infer theoretical implications, however superficially.

However, as Figure 6.3 highlights, the institutional pressures used in this comparison, although part of the overarching findings of the study (overarching finding for improving knowledge of Research Problem 2), are very broad and will often predict both high and low resistance through their subsets. This is why analysis through the lens of the strength of the farm dam institutional environment (overarching finding for improving knowledge of Research Problem 1), in combination with substantiation of all compartments of the five institutional antecedents, has elicited more meaningful results for prediction of resistance (overarching finding for improving knowledge of Research Problem 3). The discussion of the results on a more detailed basis than allowed for above permits a greater strength of farm dam institutional environment-based extraction of key findings which are discussed in the following section.

7.4.2 Detailed meaning of the findings

The following sections enable a more narrow focus to specific sustainable farm dam management pressures and resistance in particular institutional environments to facilitate development of critical findings.

- **Key finding 1: Farmers in strong sustainable farm dam management institutional environments are less likely to experience uncertainty or be disconnected so will therefore be more receptive to sustainable farm dam management practice and behaviours** (see Hypothesis 1, Section 7.3.1).

This finding is meaningful because it lends support to the notion that, not only is reducing uncertainty important for encouraging farmers to store water a certain way, but institutional pressure sources also should focus on the connectedness of the environment for farmer cohesion and solidarity as it concerns catchment community planning.

- **Key finding 2: Farmers in strong sustainable farm dam management institutional environments are likely to resist legal coercion to manage dams sustainably and in weak environments, voluntary diffusion will also be critical for low resistance** (see Hypothesis 2, Section 7.3.2).

In strong institutional environments legal coercion is strongly resisted and in weak institutional environments voluntary diffusion is more successful at predicting non-resistance. These findings provide meaningful lessons for all environments: for institutional actors endeavouring to make weak environments become strong, and institutional actors realising that legal coercion creates resistance and the need to implicate other elements of the institutional environment. Farmer education and training to encourage connectedness, which will facilitate diffusion of a water storage practice throughout a catchment or region, would be a key way to encompass dimensions beyond command and control coercion.

- **Key finding 3: In weak sustainable farm dam institutional environments if pressures are consistent with farm goals and provide some control over farm dam decisions then they will not be resisted** (see Hypothesis 3, Section 7.3.3).

In weak institutional environments, farm dam management prescription or pressure that removes water storage decision making capability is likely to be resisted strongly. This finding is paralleled by the converse discovery that in strong environments, the decision on how to manage dams is often taken away from farmers which encourages them to more passively accept farm dam management pressures. This finding is meaningful for institutions seeking certainty of water storage equity and safety, who can consider assisting farmers with their water storage decision making by removing all or part of it - as long as it remains consistent with farm goals. This would likely be in the form of institutions embracing constructive support relationships and connecting farming communities, in addition to continuing education and training of farmers.

- **Key finding 4: Industry bodies are beneficial for generating less resistance to pressure to manage dams sustainably in weak, undeveloped farm dam institutional environments** (see Hypothesis 4, Section 7.3.4).

This finding is meaningful because it highlights that industry bodies can be of critical benefit in connecting farmers to institutions, and to each other. When establishing a strong institutional environment, industry body involvement could be capitalised upon through

information, education, and connecting farmers for participation in guideline planning, development, and implementation.

- **Key finding 5: In strong farm dam management institutional environments banks and community groups can be crucial participants in reducing resistance to pressure to manage dams sustainably** (see Hypothesis 4, Section 7.3.4).

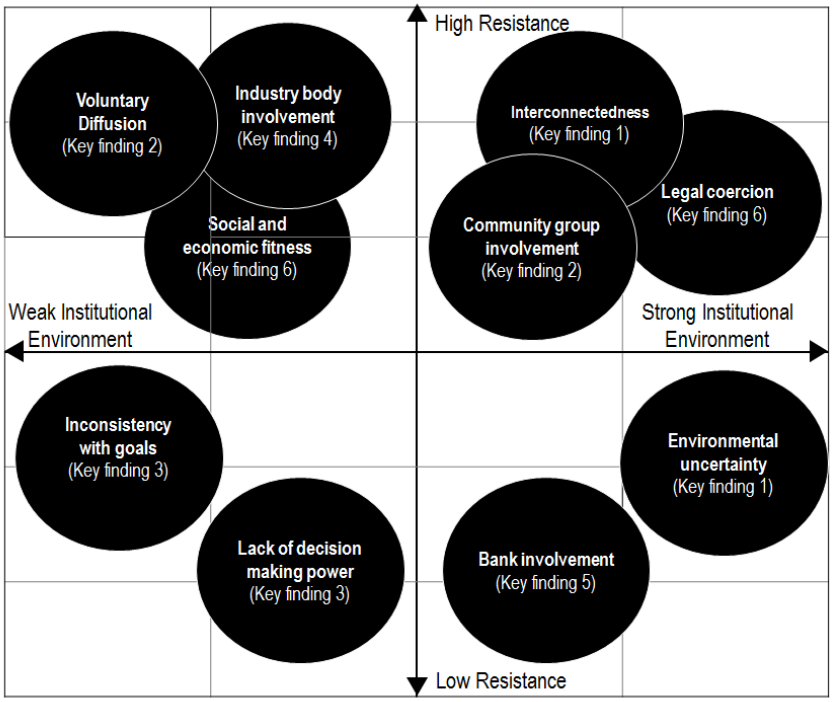
This finding is meaningful because once strong environments are established, often understanding of the most successful constituent composition is challenging to ascertain. This finding also reflects the importance of connectedness with community and neighbourhood organisations that can also have the benefit of spreading sustainable farm dam management practice throughout a region or industry.

- **Key Finding 6: If improving management of farm dams can result in economic and social improvements for the farmer, then there is likely to be less resistance to implementing sustainable dam management** practice (see Hypothesis 5, Section 7.3.5).

Social benefits can arise from sustainable farm dam management through improvements in farmer connectedness in a catchment community, region or industry. In addition, economic benefits of sustainable dam practice, such as financial incentives for good management, could also eventuate. At the very least, the social and economic benefits of managing dams sustainably to *avoid* a catastrophic dam failure on their own farm, or downstream, could be communicated.

The above key findings are summarised by Figure 7.4.

Figure 7.4 - Key findings



The following sections detail results of a study in the same field with a different approach (Pisaniello *et al*., 2012). This comparison facilitates understanding of the context of the key findings above and further leads the development of usable guidelines for farmers, policy actors and other institutions.

- **Appropriate Small Dam Management Guidelines and Demonstrative Cases Studies: Pisaniello *et al*., 2012**

The aim of this thesis was to develop understanding of poor water sharing and safety storage management in order to examine the resistance of farmers to institutional pressures to manage dams sustainably. The results in this thesis can be compared to results recently reported by Pisaniello *et al.* (2012) although distinctly different methods were employed. Pisaniello *et al*. (2012) undertook ground based photographic surveys of farm dams in Australia (see Chapter 2, Section 2.3.1 for overview of the Pisaniello *et al*. (2012) results in the context of the spillway management problem). The authors secured visibility of embankments and spillways of 504 farm dams in order to take photographs with powerful zoom photography for analysis. Results are summarised in Table 7.3 which highlights the blocked spillways and their correspondence to results of this study of the measure of strength of the institutional environment in addition to antecedents of high and low resistance to sustainable farm dam management pressure generated from the six key findings (Section 7.4.2).

Table 7.3 - Pisaniello *et al*. (2012) results from photo-interpretation of dams compared to key findings

PISANIELLO *ET AL*. 2012				THIS STUDY				
State	**Sample size**	**Mean Max. Dam Capacity (ML)** (researcher measure)	**Dams with Spillway Blockage(s) (%)**	**Sample size**	**Mean Max. Dam Capacity of largest dam (ML)** (farmer measure)	**Institutional environment strength**	**Key predictors of high resistance to managing dams sustainably**	**Key predictors of low resistance to managing dams sustainably**
South Australia	159	32.09	70.40	100	29.88	Weak	• Lack of decision making power • Inconsistency of pressure with farmer goals	• Industry body involvement • Improvements in social fitness
New South Wales	127	36.28	48.80	102	26.97	Moderate	• Inconsistency of pressure with farmer goals	• Voluntary diffusion of practice • Improvements in economic fitness
Victoria	106	24.07	62.30	100	25.53	Strong	• Threat of legal coercion	• Interconnectedness • Legal action
Tasmania	112	30.86	36.30	102	65.94	Very Strong	• Environmental uncertainty	• Community group involvement

The comparison in Table 7.3 highlights the variance in self-reported size of farm dam measures from farmers from the photographic and physical inspection data obtained by Pisaniello *et al*. (2012). However, the figures are not too disparate, with the exception of Tasmania where farmer-reported sizes of main dams are much larger. Importantly, the comparison of data in the table illustrates the percentage of blocked spillways as lowest in the very strong institutional environment of Tasmania. In South Australia, the weak institutional environment identified by this study, the blockages are the highest at 70.40% of spillways in the sample blocked by either natural or artificial means. The strong institutional environment of Victoria reports 62.30% of spillways blocked and New South Wales, the moderate environment, with less, a total of 48.80% spillways blocked. The figures of numbers of spillways blocked reinforce the critical need for mechanisms that reduce farmer resistance to pressure to manage dams sustainably. To meet that need, the key findings of this study (Section 7.4.2) have been mapped onto the Pisaniello *et al*. (2012) results in Table 7.3 to provide indicators of the strategies to reduce resistance in each state that could potentially result in lower blocked spillway numbers in each test state.

The early parts of this chapter discussed the overarching research findings of the study, which were narrowed down into a discussion of the findings of the statistical tests of hypotheses. From this discussion, placed in context of two surrounding studies, emerged the theoretically-based six key findings and their usefulness in context of the real-world problem. The following section considers implication of the research, allowing for consideration of both theoretical and practical inferences.

7.5 Implications

There are several implications from the above findings which will be discussed in the following sections commencing with theoretical implications, followed by practical implications.

7.5.1 Theoretical implications – contribution to Oliver's (1991) institutional and resource dependence framework and literature

The first implications of the study arise from testing Oliver's (1991) combination of institutional and resource dependence theories. This research discovered resistance to institutional pressures on farmers to conform to a particular management practice and thus a combination of the two theories facilitated a strategic choice approach combined with

institutional theory. This combination allowed the dominant institutional drivers, agents and actors to become the focus without losing the unique theoretical contributions of either approach. That is, by addressing how managers make discretionary choices along a spectrum of response relationships between variables could unfold which are critical to understanding farmer adaptations and behavioural responses.

The theoretical arguments advanced by this research contribute to the existing theoretical literature in three main ways as the following sections detail.

7.5.1.1 Theoretical contribution 1: Theoretical model replication and advancement

A theoretical contribution has been made through the use of Oliver's (1991) typology of strategic responses by replication and application to a specific problem in a novel area. Replications of all or parts of frameworks and studies are a critical part of theoretical advancement (Evanschitzky *et al*., 2007). The results support much of Oliver's model with 9 of the eventual 17 hypotheses supported, and understanding of the key pressures that can cause an unsustainable water storage management response advanced. Inclusion of individual constituents in the hypothesising and results progressed the model of the institutional field of the farmer to include specific influence pressure to manage dams sustainably. Furthermore, the potential for two dimensions to legal coercion variables when modelling in surrounding fields of research is possible with the study finding dual elements to legal coercion: the real action of legal coercion (such as actual field officer inspection of dam capacity or spillway safety) and the more hypothetical *threat* of legal coercion, such as the fear of fines.

7.5.1.2 Theoretical contribution 2: Inclusion of the sustainable farm dam institutional environment in modelling

The second contribution has been made through investigation of institutional environment strength in modelling. Later developments of institutional theory have recognised that institutional environments are not all uniform (Clemens & Cook, 1999; Seo & Creed, 2002) and that the condition of the environment may create room for more choice than first theorised. This research specifically addresses this through the review of the institutional environment of the area/issue under investigation, and ultimately inclusion of a measure of institutional environment in modelling and analysis.

7.5.1.3 Theoretical contribution 3: Application of institutional theory with resource dependence theory to a farming unit of analysis

By integrating the individual and organisation levels of analysis and considering farmers as 'managers' but applying organisational and institutional concepts directly to them, the study enables a new mode of application of institutional and resource dependence theories to farming and agriculture. This makes possible the generation of testable, theoretically driven models in an area in critical need of sociological research, in a way that may not have been considered by many researchers before.

In addition, the research advances literature in the knowledge of sustainable agricultural water storage and also how to encourage reduced manager resistance to pressures for other fields of research. The theme that emerges is one of *connecting* farmers and communities and this will be carried forward into the development of practical guidelines in the following section.

7.5.2 Practical implications - Key sustainable farm dam management guidelines

From the results of the study embedded in the theoretical underpinnings, there can also be inference to the real-world, with the key findings having practical and policy implications that can be used to develop guidelines for sustainable farm dam management. Generation of guidelines drawn from the findings that capitalise on the emerging theme of 'connectedness', offer practical solutions for understanding and reducing resistance to sustainable farm dam management pressures.

This section presents sustainable farm dam management guidelines developed from the key findings and their desired outcomes for reducing farmer resistance. The guidelines are presented in sections that lead with these key outcomes based upon findings in Section 7.4.2. Each section concludes with recommended practical guideline suggestions that endeavour to provide the best chance of non-resistant outcomes to sustainable farm dam management pressures.

7.5.2.1 Key Guideline 1: Reduce farm dam environmental uncertainty and increase interconnectedness amongst farmers

Environmental uncertainty and interconnectedness between farmers are significant dimensions of context that affect the farmer's conformity or resistance to institutional demands to manage dams sustainably. Farmers have a strong preference for certainty,

stability, and predictability in farming life[11]. The study finds that when the environmental context of institutional influence is highly uncertain and unpredictable, farmers exert greater effort to re-establish control and stability over future organisational outcomes and thus strongly resist pressure to manage their on-farm water storage in any other way. The study also finds that strong institutional environments will encourage low resistance to pressure in the face of uncertainty as the risks and awareness of dam failure and unfair water sharing are high.

Emerging from these findings is the awareness that encouraging connectedness through facilitation of groups of farmers working together could be beneficial for reducing resistance to sustainable farm dam management pressure. For example, co-ordinating water storage management decisions in order to create networks of fair water sharing and reduced risk of failure could have positive results in a catchment or region. The water storage decisions made by one farmer affect the operations of other farmers so this logical underpinning of connectedness requires that these decisions start to be more open and made in unison as the environment becomes increasingly uncertain.

The analysis and integration of water storage decision making in a catchment then becomes one of common property. Government can thereafter work to establish incentives for the co-ordination of water storage actions and the enforcement of agreements amongst groups of farmers. This type of mechanism would have the direct result of reducing uncertainty in the institutional environment which would reduce resistance to sustainable farm dam management pressure, as this study reports. An example of how this mechanism could transpire is through development of a not-for-profit entity, like a Neighbourhood Watch arrangement. Neighbourhood Watch as an example, has developed from its initial inception as 'the eyes and ears of the police' to a more community-based movement operating *with* police support (Laycock & Tilley, 1995). A similar arrangement is suggested by this study for farm dam sustainability where members of a neighbourhood interconnect with the support of government bodies to self-police the bad dam management behaviour by those resisting sustainable management pressures. This bad behaviour is not only causing danger to downstream farmers but also restricting water from their farming operations. However, as with Neighbourhood Watch, the strategy may not work in areas where there is low unsustainable dam management practice as there is not much scope for

[11] This premise can be found widely in the institutional theoretical literature (see Zucker, 1977; Pfeffer & Salancik, 1978; DiMaggio & Powell, 1983; DiMaggio, 1988) but is applied here directly to farming businesses, not only as organisations themselves, but perhaps even more applicable given the unpredictable nature of the natural environment on which farming is heavily reliant.

reduction in bad practice, and interest and interconnectedness therefore withers quickly (Laycock & Tilley, 1995).

Farmers may also be encouraged to undertake sustainable farm dam management collectively through more structured mechanisms in order to achieve the common goal of equitable and safe surface water storage. Incentives for active cooperation between farmers could include creating an effective inter-farm venture (Hillman & Hitt, 1999) with a focus on water in a region that includes performance measures of water use efficiency and storage safety. Co-operation could be administered by government and the incentive for sustainable farm dam management performance in the form of catchment-wide water licenses and emergency services levy rebates based on catchment-wide water performance. Rewards and penalties for overall good or poor performance in the catchment would be based on fair water sharing (Table 7.4). Cooperation at this level would result in reduced resistance by increasing connectedness but would also depend on the arrangements existing at the local level. The need for comparison between catchments demonstrates the need for a state-wide or federal approach. Ultimately, acquiescence to pressure to manage surface water storage equitably and safely depends strongly on the conditions of the local relationships of the farmer and if groups of farmers are able to adopt a co-ordinated approach to surface water management.

Table 7.4 – Key Guideline 1

Key Finding 1	Desired outcome to reduce resistance	Key Guideline 1
Farmers in strong sustainable farm dam management institutional environments are less likely to experience uncertainty or be disconnected so will therefore be more receptive to sustainable farm dam management practice and behaviours	• Reduction in environmental uncertainty • Increased interconnectedness	**Reduce farm dam environmental uncertainty and increase interconnectedness amongst farmers** • Community 'Dam-Watch' schemes • Collective water performance measures

7.5.2.2 Key Guideline 2: Reduce farm dam legal coercion and increase voluntary diffusion of good practice

With preferences for heavy regulation for issues effecting the environment (Bansal & Roth, 2000), the finding that legal coercion will be met with resistance from farmers is an important one. Without legal coercion, institutional control operates through informal institutional mechanisms such as industry bodies or community groups, whose involvement is also recommended by this study (see Section 7.4.2, Key Findings 4 and 5). When this

finding is coupled with the results that resistance to sustainable farm dam management pressure decreases with diffusion voluntarily throughout a field, a rethink is required for the way that sustainable farm dam management planning and guideline development is undertaken.

Government mandates imposed by means of authority, rather than through incentives for farmers connecting and voluntary diffusing a practice, will be unlikely to be successful in anything other than a regulatory strong, well-integrated institutional environment. This guideline emerges from these findings to suggest that if government mandates support cultural and community expectations then they will be more likely to be successful. A key strategy for policy makers is connecting farmers and improving farmer awareness of public interests for sustainable farm dams, and only escalating to coercive mechanisms where absolutely necessary. Because when sanctions for noncompliance with laws or regulations are high (for example, fines for bad farm dam management) or when mechanisms for enforcing compliance are strong and too frequently applied (for example, on-site inspections) the anticipated consequence will be resistance of farmers to pressure to improve dam management.

Guidelines could include incentives for first movers and early adopters of good dam management practice who provide an example for other farmers to imitate, increasing connectedness of farmers and voluntary diffusion. Then as the practice becomes more widespread through increasing diffusion the farmers face greater pressure to adopt the practice and behaviour to maintain legitimacy and avoid reputational damage. However, targeting the initial first movers is critical to give this strategy momentum and the premise is entirely in providing incentives for their initiative. Incentives could be in the form of rebates on water license fees, or rebates on emergency services levies or land taxes. Successful diffusion is critical because under conditions where a voluntary strategy is not implemented effectively, the results here indicate that farmers will merely compromise to fit the local expectations and possibly not change fundamental farm dam management behaviour at all (Table 7.5).

Another strategy to aid voluntary diffusion is education of the community living under a dangerous dam, or a group of dangerous farm dams, particularly above a large public dam catchment which can obviously cause catastrophic disaster on a cumulative scale. This could be in the form of publicity and community awareness at meetings, or information in mail-outs and the media. As support for safe farm dam management becomes more

broadly endorsed by the community, and they are mobilised to lobby or protest bad behaviour, the ability of farmers to avoid the pressure to manage sustainably becomes more limited as the practice is more widespread.

Whilst it is desirable for farmers to envisage scaled-back legal coercion, it will still be necessary (at least in the short term) to maintain a variety of oversight and regulatory fall-back mechanisms (in particular, performance measures) to ensure that the system actually delivers the benefits of which it is capable in principle.

Table 7.5 – Key Guideline 2

Key Finding 2	Desired outcome to reduce resistance	Key Guideline 2
Farmers in strong sustainable farm dam management institutional environments are likely to resist legal coercion to manage dams sustainably and in weak environments, voluntary diffusion will also be critical for low resistance.	• Reduction in legal coercion • Increased voluntary diffusion	**Reduce farm dam legal coercion and increase voluntary diffusion of good practice** • Education and awareness of downstream communities • First mover incentives

7.5.2.3 Key Guideline 3: Improve consistency of farm dam institutional pressures with farm goals and provide some control over, and help with, decision making

The research finds that there will be high resistance to policy that restricts farmer decision making power. Farmers must participate in the development and establishment of new policy instruments and their implementation if they are to be met with non-resistance. The possibility of a consultative or negotiating relationship to improve connectedness with farmers can predict lower resistance. A part of the key guidelines is development of strategies that are not only in line with the goals of agricultural businesses in the region, but can create the perception of water storage improvements or benefits to farmers. Here, information and education of farmers is essential to raise awareness of the financial implications of dam failure not only for their own farming operations but the cost of the consequences downstream.

In order for mechanisms to be in line with farmer goals, and to realise reduced resistance to managing dams sustainably, instrument combinations should be developed that are not exclusively dependent on the legitimacy rationality expected by conformity (as in Key Guidelines 1 and 2). The performance goals of the farmer – whether they are economic or otherwise – must be taken into account. Perceived efficiency and effective performance must be possibilities resulting from mechanisms and technical standards need to be written

to reflect that. Farmers may perceive consistency of sustainable farm dam requirements in terms of the financial efforts to bring standards into practice. In this way, government could offer economic incentives for implementation of sustainable management standards such as the waiving of water license fees, land tax rebates or technical support in the form of the provision of measurements and data for the farm and for the region. Furthermore, no loss of farmer freedom should be possible and enhancement of resource allocation decisions made obvious. Without this strategy, resistance will result as the findings suggest, and ultimately farmers will decouple from the sustainable farm dam management standards. Specifically, negotiated agreements between farmers, perhaps represented by several large industry farming businesses, and government can assist moves to better sustainable farm dam management outcomes. These will also be at less cost to both government (which may avoid or reduce the costs of standard development and monitoring) and farmers (insofar that it does not drastically limit farmer decision making or is incongruent with goals) (Table 7.6).

It is assumed that farmers will have on-farm water storage knowledge far superior to government and an awareness of how to achieve any given rural water efficiency outcome at the least cost (including through innovation). However mobilisation of key players or farming collectives may need to be through tangible incentives initially. A large industry participant could be mobilised to interconnect the industry and diffuse good practice and voluntarism (Gunningham, 2007) by imposing limits on farmers who do not meet dam management standards. It would be critical that any targets, standards, reporting requirements and deadlines, were in line with farmer goals. However, there have been problems with voluntary agreements of this nature (see OECD, 1999, includes the role of industry in the target-setting process). The weaknesses of voluntarism can often be compensated, and its strengths enhanced by combining it with minor elements of legal coercion. Regulations can help to set the boundaries of voluntary measures (OECD, 1999).

It is also suggested that an education and information strategy is employed so that farmers do not bear the full weight of farm dam decision making when they are forearmed with critical advice and guidance. As a consequence, farmers when faced with confusing and unclear farm dam decisions required of them will be less likely to buffer themselves from the vulnerabilities of operating in an unpredictable environment. Farmers could do this by stockpiling water through negligent or deliberate spillway blocking, or inadequate spillway provision. The findings of this study suggest that it is possible that some farmer's

institutional fields will be better at facilitating compliance and non-resistance to pressure than others, regardless of the extent of congruence of pressure to manage dams sustainably with farmer goals. Thus, it is recommended that as part of an education and information strategy, sustainable farm dam management mechanisms include incentives for collaborative decision making that is in lines with the goals of the farm, and those of the surrounding farmers. This could be in the form of facilitating the creation of formal or informal, in-person or online associations or groups designed to discuss on farm water storage issues in times of uncertainty in rainfall that are only set to increase with climate change. An interactive online forum could promote discussion on key farm dam issues as farmers are increasingly accessing the internet to improve their farming techniques and fulfil a variety of regulatory requirements (Wozniacka, 2011).

Table 7.6 – Key Guideline 3

Key Finding 3	Desired outcome to reduce resistance	Key Guideline 3
In weak sustainable farm dam institutional environments if pressures are consistent with farm goals and provide some control over farm dam decisions then they will not be resisted.	• Improved consistency of pressures • Less control over stressful water storage decisions	**Improve consistency of farm dam institutional pressures with farm goals and provide some control over, and help with, decision making** • Voluntarism through mobilisation of key farming businesses • Farmer education and information • Incentives for collaborative decision making

7.5.2.4 Key Guideline 4: Involve industry bodies in sustainable farm dam management

Contrary to prior research, mechanisms of dependence on government are not recommended based on the results of this study. Dependence on government can create resistance to pressure to manage dams sustainably. Rather freedom should be afforded for farmers to liaise freely with those in their institutional environment on the terms of compliance in order to reduce resistance to manage sustainably. Here, alternative key constituent involvement becomes important. Institutional constituents, including the industry bodies and community groups, can have powerful influence on farmers.

Farming industry bodies have farmers' needs as a primary interest and yet are able to have influence with government and appreciate broader policy issues that could negatively affect the sustainability of agriculture. From the findings of the study, it is suggested that farming groups and industry bodies are not only consulted widely but are involved in sustainable farm dam management standard setting and implementation. The resulting

iteration of self-regulation (Gunningham, 1995) can forestall the resistance created by legal coercion that is perceived to be incongruent with farmer goals (see Key finding 2, Section 7.4.2) and limit their water planning ability. Farming industry bodies and groups can take the lead in establishing standards in conjunction with regulators (Table 7.7).

Self-regulation, whereby an organised group regulates the behaviour of its members (OECD 1994; Gunningham, 1995) most commonly involves industry bodies setting rules and standards or codes of practice relating to the farm dam conduct of farmers in the industry. Because standard-setting and identification of breaches of sustainable farm dam conduct would be the responsibility of industry body practitioners, with detailed knowledge of the field, it would lead to more practical standards more effectively implemented. Furthermore, pushes for industry self-regulation of sustainable farm dam management can morally or ethically persuade farmers more readily than perhaps traditional regulation which is found to be resisted in the form of legal coercion (see Key Guideline 3, Section 7.4.2). Because self-regulation encourages innovation and dissemination of information about new technologies through industry networks, more rapid and improved implementation will be possible with less resistance predicted. However, although industry involvement was predicted by this study to promote compliance with institutional pressure, it does often require regulatory underpinning as a 'last port of call' for punishment of non-compliance (King & Lenox, 2000).

Table 7.7 – Key Guideline 4

Key Finding 4	Desired outcome to reduce resistance	Key Guideline 4
Industry bodies are beneficial for generating less resistance to pressure to manage dams sustainably in weak, undeveloped farm dam institutional environments.	• Involvement of industry bodies in farm dam management	**Involve industry bodies in sustainable farm dam management** • Farming industry self-regulation

7.5.2.5 Key Guideline 5: Involve banks and community groups in sustainable farm dam management planning and implementation

Even in institutional environments where good practice is in place, there is a need for involvement of private and non-profit organisations that share appreciation for farm dam sustainability issues. This additional support can not only result in innovation and sharing amongst networks, but also provide assistance with implementation where it is lacking in the form of observation and reporting. The results of the study also suggest that in a strong

well-integrated institutional environment financial providers such as banks can provide involvement to reduce resistance to sustainable farm dam management. In this situation it would be beneficial for policy makers to provide banking institutions information and education on the risk of unsustainably managed farm dams. The inclusion of the farm dam asset in financial considerations of farmers could improve the ease of implementation of policy on a regional basis.

Other non-profit organisations such as community groups could be mobilised to act on unsustainable farm dam management. The results highlight that this involvement could result in reduced resistance to managing dams sustainably. Community group involvement may be mobilised by government in terms of the provision of grants or resourcing for groups. The groups may then be able to achieve water storage sustainability goals through shared interests with farmers, downstream communities, and government. In some circumstances, guidelines for farmers from a body like a community group with an interest in saving lives and property can provide sufficient information and motivation for farmers who have a propensity to act in an appropriate way. However, in other circumstances, for instance where bad farm dam management has been a historical pattern of managing water on the farm, a more proactive form of instrument may be necessary. This would require amplification of community group involvement for more regular monitoring of unsustainably managed farm dams and review of the appropriate responses from farmers in order to contribute to resistance reduction as findings suggest. However, this may require a range of skills which are quite possibly not available to community groups and as precious mentioned, government intervention would be likely to be necessary.

Government grants could provide community groups opportunities to focus their efforts on the area of sustainable farm dam management and although they may be relatively small organisations, they can build up a level of expertise and work with government on a critical needs basis. It may then be possible to establish some form of strategic sustainable on-farm water storage planning process with participants from both public and not-for-profit sectors at a local level. Regulators would specify their objectives and identify where their interests and those of not-for-profit sector are complementary and where they are in conflict. Local governments could administer such an approach and claim funds from state or federal government for proactive water sustainability strategies. Local political support may also be possible thereby increasing the positive profile of sustainable farm dam management (Table 7.8).

Table 7.8 – Key Guideline 5

Key Finding 5	Desired outcome to reduce resistance	Key Guideline 5
In strong farm dam management institutional environments banks and community groups can be crucial participants in reducing resistance to pressure to manage dams sustainably.	• Bank involvement in sustainable farm dam management • Community group involvement in sustainable farm dam management	**Involve banks and community groups in sustainable farm dam management planning and implementation** • Financial provider involvement to improve strong policy implementation • Grants for community group involvement

7.5.2.6 Key Guideline 6: Make clear the economic and social benefit of sustainable dam management to farmers

The research finds that if farmers are socially and economically motivated and equipped to manage farm dams sustainably then they are less likely to resist the pressure to do so. If farmers do not have funds to manage dams sustainably then they will resist pressure to change their farm dam management tactics and thus many farmers will need to be given incentives or financial support to make the necessary adjustments to their water storage management. The expression of value also needs to be articulated to the farmers who must comprehend the dangerous and detrimental situation of unsustainably managed dams. Furthermore, if communities are educated about the risk they are living under and the threats to biodiversity then they can bring reputational pressure to farmers which effects social legitimacy. The health and safety of communities can be a strong element of social fitness and thus, information for and education of both communities and farmers to connect them is a critical underpinning strategy for reduced resistance to sustainable farm dam management. Implementation of a widespread program of education and information can increase social legitimacy, reducing the risk of noncompliance (Table 7.9).

Positive economic incentives could be offered to farmers to ensure their farm dam management economic goals were met based on management in a sustainable way. This could be in the form of employment of a dam safety engineer to provide advice to farmers at no charge, or rebates or subsidies on license fees or allocations charges for evidence of equitable and safe water storage. Not all farms and farmers are equally subject to normative pressures and desires for legitimacy.

Table 7.9 – Key Guideline 6

Key Finding 6	Desired outcome to reduce resistance	Key Guideline 6
If improving management of farm dams can result in economic and social improvements for the farmer, then there is likely to be less resistance to implementing sustainable dam management practice.	• Evidence of economic reward for sustainable farm dam management • Evidence of social reward for sustainable farm dam management	**Make clear the economic and social benefit of sustainable dam management to farmers** • Economic incentives • Reputational incentives

The importance of information and education underpinning all strategies cannot be understated. The lack of understanding of the consequences of unsustainable farm dam management and the subsequent lack of skills and expertise to rectify the situation are major obstacles and any strategy would be served well to have information and education in strong supply. Being aware of legal responsibilities may also encourage farmers to do the right thing. Case studies of good practice in local media or government publicity materials could be a strategy to connect farmers and enhance their social fitness as it relates to sustainable farm dam management. Connecting farmers in this way could also encourage voluntary diffusion (Key Guideline 2). However, third party involvement also becomes important as conciliatory mechanism (see Key Guidelines 4 and 5). Government's assurance that a program is going to be legitimating or reduce risk of economic losses from damage to farm infrastructure is not enough - farmer disconnect and scepticism about the social legitimacy or strategic utility of a passive response to pressure will be likely to result. If a third party can be involved at this point, it strengthens and legitimises the message to farmers about the importance of connecting with each other in order to realise catchment-wide sustainable farm dam management. The strengths and weaknesses of the study are now briefly discussed before concluding this chapter.

7.6 Strengths and weaknesses

The strengths of the study exist in its application of a strong theoretical approach to a novel real-world problem of critical importance. The study provides the foundation for use of a dual institutional and resource dependence theoretical framework which might be important to researchers investigating farming, water storage, and agricultural resource stress more broadly. The contribution of key practical guidelines for the sustainable management of farm dams will help to facilitate environmentally, socially and economically sustainable farm dam management as outlined in Chapter 2 (Section 2.3).

The weaknesses of the study include the reliance on low Cronbach's Alpha scores for several measures, particularly Context-Interconnectedness, even though these were low-item measures which inherently realise lower Alpha scores (Churchill & Peter, 1984; Peterson, 1994). This is acknowledged to be a limitation of the generalisability of study outcomes even though hypothesising surrounding Interconnectedness did not return anomalous results and every effort was made to include several dimensions of each construct rather than reliance on single–item measures. A further weakness of the study is the basis of empirical results on cross-sectional, perception-based data which can be said to require caution when generalising to real world problems (Bowen & Wiersema, 1991). There were anomalous relationships found in the data analysis that were addressed in Chapter 6. The inclusion of objective data would possibly not overcome this as some of the dichotomies were also present in the results of Clemens and Douglas' (2005) study (see Section 7.4.1). However, it is not possible on the basis of the cross-sectional analysis conducted in this study to know if, or in what ways, farmer attitudes and behaviours may evolve from one policy setting to another over time, and what may cause these changes (for example, historical behaviours, political changes). A longitudinal approach and application of Oliver's (1991) framework to the issue of sustainable farm dam management is a future research agenda.

The aforementioned weaknesses of the study must also be taken into consideration when utilising the guidelines developed based on statistical results. Inevitably assumptions had to be made, such as where low Cronbach's Alpha scores were realised as described above, and recommendations developed in this chapter are of course partially based upon those assumptions. However, the strength of the theoretical underpinnings of the research and the care taken to develop guidelines that also take into account the existing literature in the area, means that there is little indication that the guidelines developed are flawed by this process. Further research will be required to establish the extent to which these guidelines will meet the objectives of academia, policy and practice.

7.7 Summary

The main aim of this chapter was to synthesise the overarching and key findings of the study as they relate to the three elements of the research problem identified in Chapter 1. The empirical results contribute to understanding of the relationship between sustainable farm dam management pressures from the institutional environment and the farmers' resistance to these pressures. The overarching and key findings, placed in the context of a

brief comparative analysis of two other studies, enabled development of key sustainable farm dam management guidelines and recommendations. Strengths and weaknesses of the study were also addressed.

The main aim of the chapter when exploring the meaning of the empirical results, combined with the other elements of the thesis, including the institutional environment review (Chapter 3), and the development of a testable model (Chapter 4), is to contribute to solving the overarching research problem and answer the question: *How are the farmers' perceptions of sustainable farm dam management related to the institutional environment and the potential for farmer resistance to surface water storage pressures?*

In theoretical terms this study has shown that predictive relationships between sustainable farm dam management context, control, content, constituents and cause, and the farmer's response to institutional pressures to manage dams sustainably do exist and can be built upon for the development of effective practical institutional guidelines. In addition the moderating effect of a strong institutional environment is advancement on the theoretical framework that allowed several interesting relationships to emerge. Therefore, this study can be added to the body of literature that combines institutional and resource dependence theories to analyse the responses of actors to institutional pressures.

The relationships examined allow for answering of the research question through understanding of the key predictors of farm dam management resistance which then facilitated key guideline development. However, what is highlighted is that there is no single solution to the farm dam sustainability problem. Discussion of results and guidelines developed emphasise how alternative mechanisms and models will be appropriate and suitable for different contexts. It would also be expected that certain mechanisms would operate in parallel. The outcome of reduced resistance to pressure may only be possible if the combinations of institutional instruments and mechanisms are sought that achieve the desired outcome with minimum operational and economic disruption, coupled with maximum reputational benefit. In practice, developments are taking place but without significant input from farmers there will be a lack of a clear overall framework within which policy can be developed and implemented. None of the key guidelines developed guarantee sustainability of farm dams, however the results of the study allow generalisability to the population of farm dam managers in catchments and thus the maximum opportunity to guide. The conclusion, Chapter 8, follows as the final chapter in the thesis.

Chapter 8

Conclusion

8.1 Introduction

The thesis has examined sustainable farm dam management institutional environments, pressures and strategic responses in in order to achieve its aim of addressing the resistance of farmers to institutional pressures to manage dams sustainably. The real-world problem was explored in Chapter 2 with a review of the farm dam literature to develop understanding of the unsustainable farm dam management behaviour of withholding additional water than entitled to. This behaviour is not only inequitable but creates an unsafe structure bearing considerable risk of disaster with devastating consequences for farming and other businesses, communities, and biodiversity downstream. In order to explore the research problem, this real-world problem was placed in the context of a combination of institutional and resource dependence theories. This dual theoretical framework based on Oliver's (1991) modelling of strategic response typologies would provide a foundation for addressing the main research problem of deficiency of understanding of the relationship between sustainable farm dam management pressures from the institutional environment and the farmers' resistance to these pressures.

Chapter 3 addressed the first part of the research problem by exploration of the equity and safety mechanisms in the institutional environment of farmers managing farm dams (Research Problem 1/Sub-Research Question 1). Development of a model of testable hypotheses that could extract and address specifically the institutional pressures that can cause a sustainable farm dam management response from farmers was undertaken in Chapter 4 (Research Problem 2/Sub-Research Question 2). After presentation of research design and methods in Chapter 5, Chapter 6 provided statistical results based on the modelling in Chapter 4 that tested the relationship between farmers' perceptions of sustainable farm dam management in relation to the institutional environment and the potential for farmer resistance to the surface water storage pressures (Research Problem 3/Sub-Research Question 3). Chapter 7 then facilitated the development of overarching and key findings that could be used to formulate guidelines to help reduce resistance of farmers to pressure to manage dams sustainably and the mechanisms that could be in

place to reduce resistance within an institutional field of actors such as state and local regulators, industry bodies, banks, and community groups.

This final chapter of the thesis is organised as follows: Firstly, the key findings of the study will be presented followed by the contributions of the study to theory and to practice. Then, the limitations and recommendations from the study will be presented followed by a summary of the study.

8.2 Summary of key findings

The relationships examined by the thesis allowed for answering the main research question through understanding of the key findings of predictors of farm dam management resistance/non-resistance in a particular institutional environment. These key findings emphasise how alternative mechanisms and models will be appropriate and suitable for different contexts and are summarised as follows:

- Farmers in strong sustainable farm dam management institutional environments are less likely to experience uncertainty or be disconnected so will therefore be more receptive to sustainable farm dam management practice and behaviours.
- Farmers in strong sustainable farm dam management institutional environments are likely to resist legal coercion to manage dams sustainably and in weak environments, voluntary diffusion will also be critical for low resistance.
- In weak sustainable farm dam institutional environments if pressures are consistent with farm goals and provide some control over farm dam decisions then they will be less likely to be resisted.
- Industry bodies are beneficial for generating less resistance to pressure to manage dams sustainably in weak, undeveloped farm dam institutional environments.
- In strong farm dam management institutional environments banks and community groups can be crucial participants in reducing resistance to pressure to manage dams sustainably.
- If improving management of farm dams can result in economic and social improvements for the farmer, then there is likely to be less resistance to implementing sustainable dam management practice.

The theoretical and practical implications of these findings are discussed in the following sections.

8.3 Contribution to theory

The study has made a theoretical contribution at two main levels: Firstly, the thesis employs and advances a strong theoretical model by accounting for variation in Oliver's (1991) pressure-response typology across different strengths of institutional systems and with additional variables; and, secondly because the study represents a replication of a strong conceptual model in a novel area which will help researchers in agriculture and other fields apply strong theoretical constructs in a new way. These two contributions will be discussed in turn.

8.3.1 Testing Oliver's (1991) framework

Oliver's (1991) dual institutional and resource dependence theoretical framework provides a platform for explaining how organisational actors will respond to institutional pressure. Since Oliver developed the framework it has been tested in various industry settings and modified to suit numerous contexts. Using the original foundation, this study finds that the overarching variables of sustainable farm dam management context, control, content, constituents and cause do all have significant predictive ability of variation in response to sustainable farm dam management pressures. The study advances Oliver's (1991) framework, not only by using it in the novel area of agricultural surface water storage, but by (1) including individual constituents as variables of interest, and (2) including the moderating effects of the strength and level of integration of the institutional environment. The study has highlighted that the institutional environment can facilitate emergence of a variety of strategic responses to institutional pressures when the degree of choice and active resistance that farmers exhibit is not assumed to be unilateral across all institutional conditions. The contribution of these advancements will allow the framework to be developed for use in other fields with multiple strengths of institutional environment and many key actors.

8.3.2 Contribution to the literature

Despite the vast amount of work by Pisaniello (for example see Pisaniello 1997; 2009; 2010; 2011; Pisaniello & McKay, 2003, 2005, 2007; Pisaniello *et al*., 2011a, 2011b, 2012)

in the area of sustainable farm dam management, particularly safety management, a broad-scale capturing of farmer perceptions has not been undertaken to date in order to advance knowledge in the area of farmer behaviour in a systematic way as it relates to surface water storage equity and safety. Therefore, the study promotes understanding of the critical problem of unsustainable farm dam management. Pisaniello *et al*. (2011a; 2011b; 2012) provide comprehension of the extent of the problem and the very real threat of imminent catastrophe providing a basis for this study to empirically extend the work to capture perceptions of those managing the dams, thus affording confidence in the generalisability of the results.

The study also makes a contribution to the literature through application of a strong theoretical model, typically applied at the organisation level, to farmers as representatives of usually small organisations for which they are responsible. The study offers an empirical test of the model which advances knowledge for researchers in other fields applying well-established theoretical constructs, such as institutional and/or resource dependence theories in a novel way.

8.4 Contribution to practice

In practice, the results of this study not only illuminate the potential catastrophic nature of unsustainable farm dam management, but can also assist farmers, policy makers communities and other rural constituents to further develop understanding of on-farm water storage sustainable management practices. Paying special attention to the institutional environment in four states in Australia allowed for understanding of the context in which the farmers are undertaking dam management practice. The findings that emerged from within a state-based comparison facilitated richness of understanding of the critical ways in which farmer resistance can be minimised in various different contexts.

The theme of connectedness emerged from the state-based comparisons which is also a critical contribution to practice for farmers, policy actors, communities and other groups. The undercurrent of connectedness was reflected in the findings that reveal the importance of neighbour and community relations for cultivating good water management practice in a region and diffusing more broadly for less resistance to suggested changes in practice.

From these key findings, key guidelines were developed, each with practical examples and suggestions for implementation, which are summarised as follows:

- Reduce farm dam environmental uncertainty and increase interconnectedness amongst farmers:
    - Community-based 'dam-watch' schemes
    - Collective water performance measures
- Reduce farm dam legal coercion and increase voluntary diffusion of good practice:
    - Education and awareness of downstream communities
    - First mover incentives
- Improve consistency of farm dam institutional pressures with farm goals and provide some control over, and help with, decision making:
    - Voluntarism through mobilisation of key farming businesses
    - Farmer education and information
    - Incentives for collaborative decision making
- Involve industry bodies in sustainable farm dam management:
    - Farming industry self-regulation
- Involve banks and community groups in sustainable farm dam management planning and implementation:
    - Financial provider involvement to improve strong policy implementation
    - Grants for community group involvement
- Make clear the economic and social benefit of sustainable dam management to farmers:
    - Economic incentives
    - Reputational incentives

Ultimately, the study may be considered an addition to the body of literature aimed at understanding the practice of water storage management as it relates to sustainability and sustainable development. The study found that farmers often meet pressures from their institutional environment with great resistance and this is important for farmers and key institutional actors – especially in the public sector where the relationships to the private sector and their mutual social and environmental decisions underlie moves toward sustainable development. If applied to the practice of solving other critical problems facing water storage management and agricultural sustainability, the relationships uncovered could serve to illuminate strategies for sustainable development more broadly.

8.5 Limitations

Firstly, the study only examined farm dam management practices and perceptions of farmers within catchments. Therefore these results are not generalisable to the broader population of on-farm water storage management practices and responses. Second, a limitation exists in the application of established measures and theoretical constructs to such a novel area where much behaviour is not exposed to institutional pressure or if it is, there is general lack of knowledge and awareness of these institutional pressures. This is especially evidenced in several low Cronbach's Alpha reliability scores for measures realised in the results in Chapter 6. Whilst the study makes every attempt to make sure Cronbach's Alpha scores are at an acceptable level for preliminary research in a novel area (greater than 0.5, Nunnally, 1967) the researcher acknowledges the difficulties in reliance on measures that do not have strong reliability in scale development of 0.7 and above (Nunnally, 1978).

The inclusion of many independent variables and their interaction terms in moderated multiple regression can mean that the interactions between the interaction terms minimises the moderating effect of each independent variable and relationships that are significant alone, do not appear so when modelled together (see Chapter 5, Section 5.5.3.2 for discussion of Type II statistical error). Despite the correlation matrix showing that this was not a considerable problem with low correlations between interactions terms (see Appendix 6) it is nonetheless a problem inherent in moderated multiple regression with many variables. The researcher however desired the inclusion of all of the independent variables in Oliver's (1991) framework in order to maximise the explanatory power of the model and results.

8.6 Recommendations for future research

Despite the contributions to theory, and sustainable farm dam management knowledge and practice, the study highlights the need for further research. Qualitative perceptions of farmers and their on-farm water storage behaviours would benefit policy managers to have a greater understanding of the institutional and regulatory instruments in place and especially their implementation. In addition, objective measures of the independent variables of context, control, content, constituents, and cause would also provide an additional test and alternative view of predicting resistance, and could also overcome some

of the reliability and measure limitations highlighted above in Section 8.5. For example, uncertainty could be measured by regional rainfall data, or specific industry pricing fluctuations. Demographic measures of farmers would also capture increased detail for further modelling, such as age, education and experience (Smithers & Furman, 2003; Soule *et al.,* 2003).

An element of sustainable dam management behaviour not captured by this study was the possibility of beyond compliance behaviour. Rather than just acquiescing as the best option in the face of farm dam sustainability pressures, more research is warranted that explores the other end of the continuum to best practice from farmers and thus the links between institutional pressure and strategic innovation in agriculture more broadly could be explored.

Finally, longitudinal analysis of the problem is highly recommended as agricultural water management is a dynamic and constantly changing field of research, compounded by the increasing variability caused by climate change. Also, the impending changes to water allocations laws in the Western Mount Lofty Ranges of South Australia for example is an area where the strength of equity policy will improve, unmatched by strength in safety policy. A time-series study of the effect of these changes over time is warranted. In addition a study of perceptions and responses to institutional pressure directly after a dam failure disaster would also be warranted in a state like South Australia, lagging in safety policy.

8.7 Thesis summary

Ultimately, the contribution to the knowledge of the overarching research problem and answering of the main research question, *How do farmers respond to institutional pressures to manage farm dams sustainably to achieve equity between stakeholders seeking this limited surface water resource and the safety of communities?* has been achieved. The analysis of sustainable farm dam management pressures and responses in varying strengths of institutional environments contributed to theoretical advancement of a dual institutional and resource dependence framework, and also practically to the development of sustainable farm dam management guidelines.

This study provides for the first time broad-scale empirical insight to a critical surface water storage sustainability issue facing agriculture and society. The findings of this study

provide academics, farmers, policymakers and other institutional actors with recommendations and implications that will serve to improve sustainability of Australia's surface water resources. Equitable and safe farm dam management policy is a very important issue for farmers who have often worked the same land for generations and thus have intimate knowledge of the water use.

Institutional theory's focus on the stability and pressure of institutions combined with resource dependence theory's focus on the methods and benefits of noncompliance in response to external demands provides a particularly appropriate basis of comparison for revealing a comprehensive range of responses available to farmers when under pressure to conform. The results suggest that there are institutional antecedents that do have an impact on the response of farmers to sustainable farm dam management pressures and different combinations of these can be beneficial in understanding farmer water management behavioural responses when developing guidelines for practice, policy or advancement of the knowledge of water management more broadly.

When institutional actors such as policymakers are developing and implementing the optimal institutional mechanism combination, they need to also be aware of the context of the environment. Where there may be uncertainty, disconnectedness, or a lack of voluntary diffusion, strategies will need to be tailored differently to environments where pressures are consistent with farm goals and provide certainty and control over farm dam decisions. In this scenario, pressure is much less likely to be resisted. Other institutional actors such as industry bodies, community groups and banks are beneficial in the right setting and will often help in strong institutional environments where legal coercion to manage dams sustainably is strongly resisted.

Ultimately, in times of unprecedented increases in climate extremes and demands on agricultural resources, this research provides a unique understanding of the types of strategic responses to institutional pressures for sustainable water storage management. This understanding enables contribution of key implications and guidelines for the future of sustainable agricultural water storage management with the potential for inferences to be drawn to problems of water sustainability management more broadly.

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Appendix 1 – Farmer survey participant information sheet and questionnaire

University of South Australia
Centre for Accounting, Governance and Sustainability

University of South Australia
School of Commerce
GPO Box 2471
Adelaide, SA 5001

Sustainable Farm Dam Management
Ethics Protocol # 24946
Joanne Tingey-Holyoak (PhD Student)
Professor Roger Burritt and Dr John Pisaniello (Supervisors)

This is an invitation to participate in a research project being undertaken by the Centre for Accounting, Governance and Sustainability (CAGS) at the University of South Australia. The project is being undertaken with the support of the Australian Research Council (ARC) and aims to investigate farm dam management in South Eastern Australia.

The benefit of the project to us will be an understanding of the broader area of surface water resource management in _(participant's state)____. The benefit of the project to you will be an analysis of on-farm water storage management that allows for consideration of what works best for sustainable farm dams in your region. Participation will be through a 15 minute telephone survey.

The research is being undertaken in accordance with strict University of South Australia research policies and ethical standards which are available for viewing at www.unisa.edu.au/policies. As such your responses will be kept confidential by me and not identified and you may withdraw at any time without affect to your position or treatment and any participation is completely voluntary. You do not have to provide response to any question that you do not wish to answer. All information is treated in a confidential manner, and the information will be stored with no means of identification.

The data will be non-identifiable upon analysis after data collection is complete. Any records containing your personal information will remain confidential and no information which could lead to identification will be released. Please find following the details of the Ethics Committee should you have any queries or concerns about the project:

Vicki Allen
Ethics and Compliance Officer
Tel: +61 8 8302 3118
Fax: +61 8 8302 3921
Email: vicki.allen@unisa.edu.au

May I ask that you confirm that you:

- Have understood the above information and the nature and purpose of the research project has been explained to me. I understand and agree to take part.
- Understand the purpose of the research project and my involvement in it.
- Understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.
- Understand that while information gained during the study may be published, I will not be identified and my personal results will remain confidential.
- Understand the statement in the information sheet concerning payment to me for taking part in the study.

Name of participant…….....

To confirm you would like a copy of the report upon completion, please advise now or contact the researcher via email (joanne.tingey@unisa.edu.au) or phone +61 8 8302 0462 any time.
Thank you for your consideration.

Best wishes,

Joanne

Joanne Tingey-Holyoak
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University of South Australia | Centre for Accounting, Governance and Sustainability

Sustainable Farm Dam Management

Joanne Tingey-Holyoak
Professor Roger Burritt
Dr John Pisaniello

Filtering Questions

(1) Do you own/manage any farm catchment dams*? IF NO – TERMINATE

(2) How many such farm dams do you have?

(3) What size is the largest dam? IF UNDER 5 ML – TERMINATE

(4) Are there other farm dams in the region where your dam is located, for example in the upstream or downstream catchments surrounding your dam? IF NO - TERMINATE

**A catchment dam is an earthen embankment with a water storage that is naturally fed by the rainfall runoff that flows from the catchment above it – the catchment being the area of land bound by hills from which all rainfall runoff flows to the same low point where the dam is located.*

(5) Postcode: .....

(6) Main type of farming activity: .....

(7) *Details of largest dam*

(a) Size (height & capacity estimation): .....
(b) Age of dam: .....
(c) Purpose of dam: .....
(d) Who designed/built the dam, e.g. engineer, self-built, local dam builder, other: .....
(e) Who designed/built the spillway of the dam, e.g. engineer, self-built, local dam builder, other: .....
(f) Does the dam have an Emergency Action Plan to warn downstream communities in case it fails? .....

(8) Respondent gender: (from interviewer?) .....

(9) I manage my dam in the same way they have always been managed on this farm.

☐	☐	☐	☐	☐	☐	☐
Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(10) I speak with others who work on the farm about the best farm dam management approach used in the past and adopt that approach.

☐	☐	☐	☐	☐	☐	☐
Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(11) I speak with others on the farm about the best farm dam management approach they currently recommend and adopt that approach.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(12) I follow the dam management approach that is used by other successful farmers in the area.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(13) I make a conscious evaluation of specific dam laws and choose to comply with them.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(14) I communicate with the regulators to determine the best way to comply with the spirit and intent of the dam management laws.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(15) I negotiate openly with the regulators to obtain a mutually agreeable solution on management of my dam.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(16) I obtain consensus with the regulators about my farm dam management for the benefit of communities downstream.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(17) I negotiate with the regulators to obtain an advantageous situation for managing my dam.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(18) I bargain with the regulators to obtain a favourable dam management situation for the community downstream.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(19) I partially conform with the specific dam management laws that are most important to the regulators.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(20) I determine the most important elements of dam management for regulators and agree to comply.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(21) I appear to comply with dam management laws but intentionally avoid certain aspects of the requirements.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(22) I conceal certain aspects of my farm dam management from the regulators.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(23) I purposefully block my spillway to build up my water supply.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(24) I avoid in dealing with any industry bodies that are worried about dam management.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(25) I would consider removing spillway blockages to avoid detection by regulators.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(26) I would consider growing intense vegetation near the dam to remove access by regulators.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(27) I get on with my business as usual rather than worrying too much about compliance with dam management regulations.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(28) Dam management regulations are ineffective and I attempt to avoid any discussion of regulations with regulators.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(29) I would sue the regulatory agency for overly burdensome dam management requirements.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(30) I would challenge dam management requirements in court.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(31) I would challenge dam management requirements through the media.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(32) I would mount a campaign with the farmers around me and the community to attack the regulatory authority about dam management laws.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(33) I attempt to form an alliance with the regulators regarding my dam management.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(34) I attempt to include a regulator in my dam management decision-making.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(35) I attempt to influence public perceptions on how well I manage my dam.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(36) I organise the farmers around me and the community to attempt to influence the dam management regulatory requirements.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(37) I meet with elected politicians to attempt to control the regulators on dam management issues.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(38) I attempt to deal with federal regulators to control the state and local government on dam management issues.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(39) I think the spillways of my dam are safe.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(40) My annual budget includes an amount that allows me to maintain the safety of my dam as part of my dam management.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(41) My annual budget includes an amount that allows me to check and ensure my spillway satisfies current safety standards.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(42) My dam has never failed.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(43) I am confident my dam will not fail in the future.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(44) Dam maintenance is important to me.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(45) I periodically review the safety of my dam as part of my farm dam management.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(46) The authority periodically checks my water meter.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(47) The farmers around me share the water fairly.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(48) The laws require me to provide too much water for the environment.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(49) The maximum storage capacity of my dam is checked periodically.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(50) Regulations require me to have an Emergency Action Plan for my dam as part of my dam management.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(51) Regulations require me to periodically report on the safety of my dam as part of my dam management.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(52) Regulations require me to periodically report on the spillway capacity of my dam as part of my dam management.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(53) I am worried about the future of water availability to continue my farming operations.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(54) I block my spillway to store more water because of the uncertainty of future runoff in my region.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(55) Most of the farmers in my region manage their dams in the same way.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(56) I have worked with other farmers on dam management issues.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(57) I have received a notice from the regulator to change my dam management practice.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(58) I am fearful of enforcement of dam management laws by regulators.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(59) The regional field officer periodically checks my dams.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(60) My neighbours and I manage our dams in a way that limits the impact of our farming operations, not because of any regulations.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(61) There is no need for so much regulation of dams as farmers around me do the right thing anyway.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(62) The dam management regulations restrict me from storing water for my usual farming operations.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(63) I am limited by the laws that tell me how I must store the water in my dam.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(64) The dam management regulations are not in line with the goals of this farm.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(65) I feel pressure from government about my dam management behaviour.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(66) I am dependent on government for dam management information and education.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(67) My farming industry association guides me on the best way to manage my dam.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(68) My insurance policy has a clause related to farm dams.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(69) My bank requires information about my farm dam.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(70) I discuss with local environmental groups the best way to manage my dam.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(71) I attend local community meetings that discuss farm dam issues.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree

(72) I have changed my dam management practice because of an article in the media.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(73) There are too many organisations putting pressure on me about my farm dam.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(74) I depend on government funding so that is why I comply with what the regulators want for my dams.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(75) Part of my reason for compliance with dam management regulations is not to disadvantage the farmers downstream.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(76) I have had complaints about my dam management from my neighbours.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(77) I have never been concerned about the way in which my upstream neighbours manage their dams.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

Ask (78) - (79) of only those participants that disagree with (77) (3 categories of disagreement):
(78) I am concerned is in relation to the safety of the upstream dams.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(79) I am concerned about the amount of water stored in the upstream dams.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(80) I have never been concerned about the impact that my dam management could have on my downstream neighbour's dam(s).

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

Only ask (81) – (84) of those participants that disagree with this:

(81) My concern about the impact of my dam management extends only to my neighbour directly downstream of me.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(82) My concern of the impact extends to all the dam owners in the catchment below my dam.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(83) My concern of the downstream impact is in relation to the safety of the dams.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(84) My concern of the downstream impact is in relation to the amount of water available for storing in the dams.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(85) Who provided the most recent assessment of the storage capacity of your dam.
Original designer
Original builder
An engineer/surveyor
An authority
You yourself
Other? Who_____

(86) Has this assessment been provided to the authority? Yes / No

(87) Remembering all of your details are confidential, what is your approx. annual income?

$1,001 to less than $14,999pa
$15,000 to less than $24,999pa
$25,000 to less than $34,999pa
$35,000 to less than $44,999pa
$45,000 to less than $54,999pa
$55,000 pa or more

(88) This farming business' profitability has been increasing over the last 5 years.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(89) My farming income has been increasing over the last 5 years.

Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
☐	☐	☐	☐	☐	☐	☐

(90) Of your total income what % is derived from the farm ____% and what % is derived from non-farming activities? ____%

(91) Does the farm have employees?___If so, how many?
1) 1-5
2) 5-10
3) 11-15
4) 16-20
5) 20+

(92) How many hectares are being farmed_____ hectares.

(93) Which of the following includes your age:
1) Less than 18
2) 18 to 20
3) 21 to 30
4) 31 to 40
5) 41 to 50
6) 51 to 60
7) 61 or older

(94) What is your highest level of schooling reached?
1) Year 10 or below
2) High school certificate
3) TAFE/other certificates
4) University degree
5) Post graduate studies

(95) Number of years spent farming:
1) 1-5 years
2) 6-10 years
3) 11-15 years
4) 16-20 years
5) 20-25 years
6) 25-30 years
7) 30+ years

(96) How old is this farm?_____years

(97) How long have you worked on this land?_____years
1) 1-10 years
2) 11-15 years
3) 16-20 years
4) 21-25 years
5) 26-30 years
6) 30+ years

Appendix 2 – Survey Instrument Item Justification

- **DV1 – Acquiescence:** The six items designed to measure Acquiescence were developed based on Clemens and Douglas' (2005) application of Oliver's (1991) strategic response typology to the steel industry. The first measure for the Acquiescence dependent variable, *ACQU1: I manage my dam in the same way we always have on this farm,* was developed based on Clemens and Douglas' (2005, p.1212) survey item "I follow the approach most commonly used in the past by our organization" adapted to relate to farm dam management by reference to historical farm dam management behaviours (Pisaniello & McKay, 2007). The second measure, *ACQU2: I speak with others who work on the farm and adopt the best farm dam management approach used in the past*, was based on Clemens and Douglas' (2005, p.1212) survey item "I speak with others in our firm and adopt the most effective approach used in the past." The third item designed to measure DV1 – Acquiescence, *ACQU3: I speak with others who work on the farm about the best farm dam management approach they currently recommend and adopt that approach*, is based on Clemens and Douglas' (2005, p.1212) survey item "I speak with other successful associates in our firm and adopt a similar position", tailored to suit the dam management specific farm dam management situation under investigation (Pisaniello *et al.*, 2011b; Pisaniello *et al.*, 2012). The fourth item designed to measure Acquiescence, *ACQU4: I follow the dam management approach that is used by other successful farmers in the area*, is based on Clemens and Douglas' (2005, p.1212) survey item for the steel industry: "I follow the approach used by successful managers in other steel firms." The fifth item designed to measure Acquiescence is *ACQU5: I make a conscious evaluation of specific dam laws and choose to comply with them*, based on Clemens and Douglas' (2005, p.1212) survey item "I make a conscious evaluation of the specific regulatory requirements and choose to comply with them." And finally, the sixth item designed to measure a passive response to pressure, *ACQU6: I communicate with the regulators to determine the best way to comply with the spirit and intent of the dam management laws*, is also based on Clemens and Douglas' (2005, p.1212) approach to the steel industry and the authors' survey item: "I communicate with the relevant regulators to determine the best way to comply with the spirit and intent of the requirements". For all items within this level of the dependent variable, similar measures have also been utilised by other institutional and resource dependence theorists (Meyer & Rowan, 1977; Pfeffer & Salancik, 1978; Scott, 1987;

Orton & Weick, 1990; D'Aunno, 1991; Etherington & Richardson, 1994; Ingram & Simons, 1995; Scott, 2001; Goodstein, 1994; Bansal, 2005).

- **DV2 – Compromise:** Each of the six items designed to measure Compromise (DV2) were also based on Clemens and Douglas' (2005) application of Oliver's (1991) strategic response typology to the steel industry. Each measure will be discussed as follows. The first item, *COMP1: I negotiate openly with the regulators to obtain a mutually agreeable solution on management of my dam*, was established from Clemens and Douglas' (2005, p.1212) measure "I negotiate openly with the regulators to obtain a mutually agreeable solution." The second item was also based directly on the Clemens and Douglas (2005, p.1212) measure, but also tailored to suit the farm dam-specific situation of the research – the measure utilised was *COMP2: I obtain consensus with the regulators about my farm dam management for the benefit of communities downstream*, based on "I obtain a consensus between the regulators and our owners and customers". The third item designed to measure a low resistance level was *COMP3: I negotiate with the regulators to obtain an advantageous dam management situation for the community downstream*. This was based upon the Clemens and Douglas (2005, p.1212) measure but tailored to the farm dam management context: "I negotiate with the regulatory organizations to obtain an advantageous solution." Clemens and Douglas' (2005) measure for the fourth item designed to measure a compromise level of resistance to sustainable farm dam management pressure was "I bargain with the regulators to obtain a favorable position for our owner(s) and customers." The measure utilised for this research was based completely on this measure but adapted to sustainable farm dam management and the consideration of the main stakeholders of unsustainable behaviour – downstream communities: *COMP4: I bargain with the regulators to obtain a favourable dam management situation for the community downstream*. The fifth item designed to measure compromise adapted to farm dam management was *COMP5: I partially conform with the specific dam management laws that are most important to the regulators*, was based upon Clemens and Douglas' (2005, p'.1212) established measure "I partially conform with the required procedures that are the most important to the regulators". The sixth, and final item designed to measure compromise was *COMP6: I determine the most important elements of dam management for regulators and agree to comply*. This item was also based upon a Clemens and Douglas' (2005, p'.1212) established measure: "I determine the most important elements for the

regulators and agree to comply". All of the aforementioned items were developed in close consultation with the established institutional and resource dependence theoretical literature, sustainable management, and farm dam management literature (e.g. Meyer & Rowan, 1977; Pfeffer & Salancik, 1978; Scott, 1987; Orton & Weick, 1990; D'Aunno, 1991; Etherington & Richardson, 1994; Ingram & Simons, 1995; Scott, 2001; Goodstein, 1994; Bansal, 2005; Pisaniello & McKay, 2007; Pisaniello *et al.*, 2011b; Pisaniello *et al.*, 2012).

- **DV3 – Avoidance:** The first item designed to measure Avoidance (DV3) was based upon Clemens and Douglas' (2005) interpretation of Oliver's (1991) strategic response typology. The Clemens and Douglas (2005, p.1212) established measure "I appear to comply but intentionally avoid certain aspects of the requirements" was applied to farm dams and also utilised for this research: *AVOID1: I appear to comply with dam management laws but intentionally avoid certain aspects of the requirements*. Similarly, the second item design to capture a dimension of Avoidance of pressure was Clemens and Douglas' (2005) established measure "I conceal certain aspects of our strategy from the regulators", tailored to the farm dam management setting for this research for *AVOID2: I conceal certain aspects of my farm dam management from the regulators*. The third item designed to measure this middle of the range Avoidance response to pressure to manage farm dams sustainable was based upon Clemens and Douglas (2005, p.1212) established measure specifically for the steel industry "I reduce the sensitivity of our detectors to avoid identifying incoming radioactive contamination" and adapted for the farm dam management area of spillway blocking, a very common unsustainable management activity - *AVOID3: I purposefully block my spillway to build up my water supply.* The fourth dimension designed to measure Avoidance was also based upon Clemens and Douglas (2005, p.1212) established measure "I avoid participating in trade association activities that deal with radioactive scrap metal." This measure was tailored to farm dam management *for AVOID4: I avoid in dealing with any industry bodies that are worried about dam management*. The fifth item designed to measure Avoidance, *AVOID5: I would consider moving spillway blockages to avoid detection by regulators*, was based upon Clemens and Douglas (2005, p.1212) established measure "I would consider moving our operations out of state to avoid oversight." And finally, *AVOID6: I would consider growing intense vegetation near the dam to remove access to regulators*, was based upon Clemens and Douglas (2005, p.1212) established measure "I would consider moving the

operations overseas to minimize the potential for oversight." However, the impossibility of moving farm dams and farming operations between locations meant that the measures were altered slightly to be in line with farm dam literature (Pisaniello & McKay, 2007; Pisaniello *et al.*, 2011b; Pisaniello *et al.*, 2012) however the author believes the original intent remains.

- **DV4 – Defiance:** Each of the six items designed to measure Defiance (DV4) were based on Clemens and Douglas' (2005) application of Oliver's (1991) strategic response typology to the steel industry. Each measure will be discussed as follows. The first item was established from Clemens and Douglas' (2005, p.1212) application with the item *DEFI1: I ignore the dam management regulations and just get on with my business*, based upon the very similar "I ignore the requirements and continue doing business as usual." The second item was also based directly on the Clemens and Douglas (2005, p.1212) measure but also tailored to suit the farm dam-specific situation of the research – the measure utilised was "I dismiss the requirements and attempt to avoid any discussion with the regulators" and the measure developed replaced 'dismiss' with 'ignore', based on the farm dam management literature (Pisaniello & McKay, 2007; Pisaniello *et al.*, 2011b; Pisaniello *et al.*, 2012) resulting in *DEFI2: I ignore the dam management regulations and attempt to avoid any discussion with regulators*. The third item designed to measure a Defiant response to pressure was based upon Clemens and Douglas' (2005, p.1212) measure that was employed for the steel industry "I would attempt to sue the regulatory agency for the overly burdensome requirement", and tailored to dam regulations for this study, *DEFI3: I would sue the regulator agency for overly burdensome dam management requirements*. The fourth element of Defiance, *DEFI4: I would challenge dam management requirements in court*, was a measure also based upon Clemens and Douglas (2005, p.1212) measure, again tailored to be targeted at dam management specifically, rather than the more general "I would challenge the requirements in court". The fifth item designed to measure Defiance, had a media focus, *DEFI5: I would challenge dam management requirements through the media*. The basis for this was also a more general approach from the Clemens and Douglas (2005, p.1212) established measure: "I would challenge the requirements in the media". Finally, the sixth item designed to measure Defiance, was based upon a Clemens and Douglas (2005, p.1212) measure ("I would mount a campaign with our suppliers and customers to attack the regulatory authority") and placed in the context of the farming community,

DEFI6: I would mount a campaign with the farmers around me and the community to attack the regulatory authority about dam management laws.

- **DV5 – Manipulation: :** All six items to measure the strongest resistance to pressure (Manipulation, DV5) were developed based on Clemens and Douglas' (2005) application of Oliver's (1991) strategic response typology to the steel industry. The first item, *MANI1: I attempt to form an alliance with the regulators regarding my dam management,* was based directly upon Clemens and Douglas' (2005, p.1212) survey item "I attempt to form an alliance with the regulators". The second measure, *MANI2: I attempt to include a regulator in my dam management decision making*, was based on Clemens and Douglas' (2005, p.1212) survey item "I attempt to include a member of the regulators on an advisory board to oversee operations" but obviously tailored to a setting where there is likely to be an absence of a formal "Board" company structure (e.g. sole-operator farmer, farming family business etc.). The third item designed to measure DV5 – Manipulation, *MANI3: I attempt to influence public perceptions on how well I manage my dam*, is based on Clemens and Douglas' (2005, p.1212) survey item, specific to radioactive steel, "I attempt to influence public perceptions on the need for cost effective requirements to avoid radioactive contamination". However, this measure too was tailored to suit the dam management specific farm dam management situation under investigation. The fourth item designed to measure Manipulation *MANI4: I organise the farmers around me and the community to attempt to influence the dam management regulatory requirements*, is based on Clemens and Douglas' (2005, p.1212) more general survey item: "Organize our suppliers and customers to attempt to influence the requirements". The fifth item designed to measure Manipulation is *MANI5: I meet with elected politicians to attempt to control the regulators on dam management issues*, based on Clemens and Douglas' (2005, p.1212) survey item "I meet with elected legislatures to attempt to control the regulators". Finally, the sixth item designed to measure a manipulative and most strongly resistant response to pressure, *MANI6: I attempt to deal with federal regulators to control the state and local government on dam management issues*, is a dam management-specific approach to Clemens and Douglas' (2005, p.1212) survey item: "I attempt to deal with federal regulators to control the state or local government".
- **IV1a, Context – Environmental Uncertainty:** The items designed to measure Context – Environmental Uncertainty, are not based on established measures but developed in strict accordance with Oliver's (1991, p.170) conceptualisation of the

variable as a measure of unease about the future state of the organisation's environment, founded in Pfeffer and Salancik's (1978) seminal theorising. This does not simply relate to the natural environment but a preference for predictability in all senses of the term 'environment' (Meyer & Rowan, 1977; Zucker, 1977; DiMaggio & Powell, 1983; Meyer *et al.,* 1983) and the need to create an illusion of control and predictability within that environment (Scott, 1987; DiMaggio, 1988; Goodstein, 1994). The farm dam management literature indicates this uncertainty relates to water resource availability for storage for farming operations as a critical and the principal way to regain control of the resource can often be spillway blocking (Pisaniello et al., 2012). Thus the two measures are broken down to capture the uncertainty for the future element (*CONTX-ENV1: I am worried about the future of water availability to continue my farming operations*), and the efforts to regain control (*CONTX-ENV2: I block my spillway because of the uncertainty of future runoff in my region*).

- **IV1b, Context – Interconnectedness:** The three items designed to measure Context-Interconnectedness are not established measures but have foundations firmly embedded in the related literature. Oliver's (1991, p.171) interpretation of Interconnectedness, which is based upon a nexus of the institutional and resource dependence theoretical literature (DiMaggio & Powell, 1983; Hamel *et al.*, 1989; Jennings & Zandbergen, 1995; Sadorsky, 1996; Florida & Davidson, 2001; Raines, 2002), suggests that organisations will create relational networks that elaborate operational norms, and even myths (*CONTX-INTER1: Most of the farmers in my region manage their dams in the same way*). In addition, Clemens & Douglas (2005) asked respondents in the steel industry, the degree to which their firm had worked with other firms on environmental issues (*CONTX-INTER2: I have worked with other farmers on dam management issues*). Furthermore, a measure was developed to capture the dimension of the specific element of water sharing behaviour based on the farm dam literature (Pisaniello *et al.*, 2011a), *CONTX-INTER3: The farmers around me share the water fairly.*
- **IV2a, Control – Legal Coercion:** The measure of Control-Legal Coercion was not based on an established measure specifically but was founded in the surrounding literature. The complexity of the construct meant that the study endeavoured to capture as many dimensions of the construct as possible for testing and apply specifically to farm dams based on the related literature (Pisaniello *et al.*, 2011a). A series of measures were developed based specifically on sustainable farm dam management

research (*CONTR-LEG1: I have received a notice from the regulator to change my dam management practice; CONTR-LEG3: The regional field officer periodically checks my dams; CONTR-LEG6: The authority periodically checks my water meter; CONTR-LEG7: The laws require me to provide too much water for the environment; CONTR-LEG8: The maximum storage capacity of my dam is checked periodically; CONTR-LEG9: Regulations require me to have an Emergency Action Plan for my dam as part of my dam management; CONTR-LEG10: Regulations require me to periodically report on the safety of my dam as part of my dam management*). The remainder of the items were based on the Oliver (1991, p.168) conceptualising that considers the fear of organisations to tangible or severe losses caused by legal coercion (see also DiMaggio & Powell, 1983; Wood, 1991; Jennings & Zandbergen, 1995; Weaver *et al.*, 1999; Bansal, 2005), that is - *CONTR-LEG2: I am fearful of enforcement of dam management laws by regulators*. Furthermore, the added scrutiny on organisations caused by legal coercion can create a pressure situation (*CONTR-LEG4: I feel pressure from government about my dam management behaviour*), and even dependence on the regulator to avoid fines and sanctions (Oliver, 1991) (*CONTR-LEG5: I am dependent on government for dam management information and education*).

- **IV2b, Control – Voluntary Diffusion:** Control-Voluntary Diffusion was a measure that was not established specifically but was founded in close consultation with the literature (Tolbert & Zucker, 1983; Fligstein, 1985; Oliver, 1991, p.168). Voluntary diffusion measure the extent to which a practice has diffused throughout a region for reasons other than regulation, such as an organisation's attempt to limit their impact on the social or natural environment (*CONTR-VOL1: My neighbours and I manage our dams in a way that limits the impact of our farming operations, not because of any regulations;* and *CONTR-VOL2: There is no need for so much regulation as farmers around me do the right thing anyway*). The study endeavoured to capture an additional dimension of this construct related to the farm dam management literature that suggests that poor spillway management is a major cause of inequitable and unsafe water sharing and storage (Pisaniello *et al.*, 2011a). The existence of voluntary diffusion of sustainable farm dam management throughout a region or industry would result in the perception of safe spillways - *CONTR-VOL3: I think the spillways of my dam are safe.*

- **IV3a, Content – Lack of Decision Making Power:** The items designed to measure Content – Lack of Decision Making Power were not established measures but based on the logical foundations of Oliver's (1991, p.166) theorising, in itself drawn from resource dependence and institutional theory (Thomson, 1967; Cook, 1977; Pfeffer & Salancik, 1978; Meyer *et al.*, 1983). Ultimately, the consensus is that lack of decision making power manifests in the loss of discretionary choices over decisions such as resource storage or allocation (Oliver, 1991, p.166). Therefore, the following measures were developed: *CONT-DEC1: The dam management regulations restrict me from storing water for my usual farming operations,* and *CONT-DEC2: I am limited by the laws that tell me how I must store my water in my dam.*
- **IV3b, Content – Consistency of Organisational Goals:** The item designed to measure Content - Consistency of Organisational Goals is also not an established measure but founded in the related literature (Powell & Freidkin, 1986; Covaleski & Dirsmith, 1988; Ingram & Simon, 1995; Bansal & Roth, 2000) and applied to the farm dam management setting (Pisaniello *et al.*, 2012). The marriage of technical standards and institutional objectives with organisational goals and outcomes is important for consistency to occur (Oliver, 1991, p.165). Thus, the item designed to reflect this is: *CONTE-CONS: The dam management regulations are not in line with the goals of this farm*.
- **IV4a, Constituents – Multiplicity:** The measure of Constituents - Multiplicity was not established in the literature but instead designed to reflect the intent of the Oliver (1991, p.162) as a measure of multiple conflicting pressures. Therefore the industry-specific element was captured from the farm dam management literature (Pisaniello *et al.*, 2012) and built upon to derive a measure that reflects incompatible (Pfeffer & Salancik, 1978; Whetten, 1978; D'Aunno, 1991; Cashore & Vertinsky, 2000) or competing demands - *CONST-MULT: There are too many organisations putting pressure on me about my farm dam*.
- **IV4b, Constituents – Dependence:** The item designed to measure Constituents – Dependence, was not an established measure. The related theoretical literature (Pfeffer & Salancik, 1978; DiMaggio & Powell, 1983), upon which Oliver's (1991) theoretical framework is based was employed for this study. The measure (*CONST-DEP: I am dependent on government funding so that is why I comply with what the regulators want for my farm dam*) reflects the intent of the measure and the possible

dependence, though financial means, upon institutions that are exerting pressure on the organisation (Oliver, 1991, p.163).

- **IV4 Sub 1, Constituents – Specific Constituent Pressures:** Based on the Clemens and Douglas (2005, p.1209) interpretation of Oliver's (1991) theoretical framework, and the surrounding theoretical literature (DiMaggio & Powell, 1983; Campbell, 2007) the survey items for Constituents (IV4) included questions about specific constituents relevant to the industry as follows:

  Industry Groups - *CONST-SUB1: My farming industry association guides me on the best way to manage my dam* (Gupta & Lad, 1983; Weaver *et al.*, 1999; Hoffman, 2001).

  Insurers and Banks - *CONST-SUB2a: My insurance policy has a clause related to farm dams*; and *CONST-SUB2b: My bank requires info about my farm dam* (Elkington, 1994; Jennings & Zandbergen, 1995; Hoffman, 2000a; 2000b; Campbell, 2007).

  Community Groups - CONST-SUB3: I attend local community meetings that discuss farm dam issues (Jennings & Zandbergen, 1995; Henriques & Sadorsky, 1996; Raines, 2002; Delmas & Toffel, 2004; Schneiberg & Soule, 2005; Campbell, 2007).

  Environmental Groups - *CONST-SUB4: I discuss with local environmental groups, the best way to manage my dam* (Elkington, 1994; Hamilton, 1999; Cashore & Vertinsky, 2000; Maxwell *et al.*, 2000; Brooks, 2002).

  Media - *CONST-SUB5: I have changed my dam management practice because of an article in the media* (Lawrence & Morell, 1995; Bansal & Roth, 2000; Bansal & Clelland, 2004; Bansal, 2005; Campbell, 2007).

- **IV5a, Cause – Social Fitness:** The items designed to measure Cause-Social Fitness were not established in the literature but based on interpretation of Oliver's (1991, p.161) theorising about the ways to increase social fitness, including pleasing or placating regional or industry networks to gain legitimacy (Tolbert & Zucker, 1983; Etherington & Richardson, 1994; Fligstein, 1985; DiMaggio & Powell, 1991). The measure, *CAUS-SOC1: I comply with dam management regulations so I do not upset the farmers downstream,* was also complemented with the dimension from the farm dam management literature that considers the complaints and fear element of being socially unfit in a farming setting (Pisaniello & McKay, 2007) - *CAUS-SOC2: I have had complaints about my dam management from neighbours.*

- **IV5b Cause - Economic fitness:** The two items designed to measure Cause - Economic Fitness were not based on established measures but derived in strict

accordance with the meaning expressed in Oliver's (1991) conceptual framework of strategic response to pressure in addition to the surrounding sustainable management and farm dam management literatures. Oliver (1991, p.160-161) describes economic fitness a higher degree of economic gain perceived to be attainable from conformity to institutional pressures which was combined with the notion in the sustainability literature of economic fitness is described as allowing or budgeting for conditions that create opportunities for organisations to avoid disregarding social welfare, for example safety, environmental damage or deceive regulators (Vogel, 1992; Albert, 1993; Dore, 2000; Roe, 2003; Campbell, 2007). Thus, the notion of 'budget' was important and when combined however the farm dam management literature suggests that when the perception of economic gain is low (such as the requirement to spend money to maintain a spillway (Pisaniello & McKay, 2007) despite the farmer perceiving that the dam poses no threat to lives or property) then the farmer will be unlikely to manage dams safely. Thus this resulted in the generation of the first measure *CAUS-ECO1: My annual budget includes an amount that allows me to check and ensure my spillway satisfies current safety standards,* which was designed to satisfy the budgeting element of economic fitness notion, combined with the critical farm dam literature. The second item encompassed a broader notion of budgeting and economic fitness focussed on overall dam management, rather than just spillways: *CAUS-ECO2: My annual budget includes an amount that allows me to maintain the safety of my dam as part of my dam management.*

Appendix 3 – Means, standard deviations, and variance for each observed continuous variable

Variable	Construct	**Observed Variable** (Likert 1-7 scale)	Mean	SD	Variance
DV1	Acquiescence	ACQU1: I manage my dam in the same way we always have on this farm	3.02	0.82	0.67
		ACQU2: I speak with others who work on the farm and adopt the best farm dam management approach used in the past	3.76	1.07	1.14
		ACQU3: I speak with others who work on the farm about the best farm dam management approach they currently recommend and adopt that approach	3.67	1.04	1.07
		ACQU4: I follow the dam management approach that is used by other successful farmers in the area	3.41	0.91	0.83
		ACQU5: I make a conscious evaluation of specific dam laws and choose to comply with them	3.60	0.94	0.88
		ACQU6: I communicate with the regulators to determine the best way to comply with the spirit and intent of the dam management laws	4.14	1.00	1.01
DV2	Compromise	COMP1: I negotiate openly with the regulators to obtain a mutually agreeable solution on management of my dam	4.09	1.07	1.14
		COMP2: I obtain consensus with the regulators about my farm dam management for the benefit of communities downstream	4.06	0.97	0.93
		COMP3: I negotiate with the regulators to obtain an advantageous dam management situation for the community downstream	4.43	0.91	0.83
		COMP4: I bargain with the regulators to obtain a favourable dam management situation for the community downstream	4.47	0.93	0.86
		COMP5: I partially conform with the specific dam management laws that are most important to the regulators	3.65	0.97	0.94
		COMP6: I determine the most important elements of dam management for regulators and agree to comply	3.59	0.91	0.82
DV3	Avoidance	AVOID1: I appear to comply with dam management laws but intentionally avoid certain aspects of the requirements	4.40	0.98	0.97
		AVOID2: I conceal certain aspects of my farm dam management from the regulators	4.83	0.85	0.73
		AVOID3: I purposefully block my spillway to build up my water supply	5.03	0.76	0.57
		AVOID4: I avoid in dealing with any industry bodies that are worried about dam management	4.27	1.03	1.06
		AVOID5: I would consider moving spillway blockages to avoid detection by regulators	4.69	0.81	0.65
		AVOID6: I would consider growing intense vegetation near the dam to remove access to regulators	4.94	0.71	0.51
DV4	Defiance	DEFI1: I ignore the dam management regulations and just get on with my business	3.13	0.97	0.95
		DEFI2: I ignore the dam management regulations and attempt to avoid any discussion with regulators	4.12	1.06	1.12
		DEFI3: I would sue the regulator agency for overly burdensome dam management requirements	4.35	1.06	1.13
		DEFI4: I would challenge dam management requirements in court	4.22	1.04	1.08
		DEFI5: I would challenge dam management requirements through the media	4.19	1.07	1.15
		DEFI6: I would mount a campaign with the farmers around me and the community to attack the regulatory authority about dam management laws	3.97	1.18	1.38
DV5	Manipulation	MANI1: I attempt to form an alliance with the regulators regarding my dam management	4.38	0.97	0.95
		MANI2: I attempt to include a regulator in my dam	4.36	1.03	1.06

		management decision making				
		MANI3: I attempt to influence public perceptions on how well I manage my dam		4.32	0.98	0.96
		MANI4: I organise the farmers around me and the community to attempt to influence the dam management regulatory requirements		4.58	0.91	0.84
		MANI5: I meet with elected politicians to attempt to control the regulators on dam management issues		4.64	0.94	0.89
		MANI6: I attempt to deal with federal regulators to control the state and local government on dam management issues		4.39	0.92	0.95
IV1a	Context	Environmental uncertainty	CONTX-ENV1: I am worried about the future of water availability to continue my farming operations	3.70	1.3	1.69
			CONTX-ENV2: I block my spillway because of the uncertainty of future runoff in my region	4.99	0.70	0.49
IV1b		Inter-connectedness	CONTX-INTER1: Most of the farmers in my region manage their dams in the same way	3.06	0.71	0.51
			CONTX-INTER2: I have worked with other farmers on dam management issues	4.16	1.07	1.14
			CONTX-INTER3: The farmers around me share the water fairly	3.21	0.86	0.73
IV2a	Control	Legal coercion	CONTR-LEG1: I have received a notice from the regulator to change my dam management practice	5.05	0.62	0.38
			CONTR-LEG2: I am fearful of enforcement of dam management laws by regulators	3.69	1.24	1.55
			CONTR-LEG3: The regional field officer periodically checks my dams	4.61	1.02	1.04
			CONTR-LEG4: I feel pressure from government about my dam management behaviour	4.33	1.12	1.25
			CONTR-LEG5: I am dependent on government for dam management information and education	4.56	0.96	0.91
			CONTR-LEG6: The authority periodically checks my water meter	4.34	1.00	1.00
			CONTR-LEG7: The laws require me to provide too much water for the environment	4.40	0.90	0.81
			CONTR-LEG8: The maximum storage capacity of my dam is checked periodically	4.14	1.09	1.19
			CONTR-LEG9: Regulations require me to have an Emergency Action Plan for my dam as part of my dam management	4.49	0.81	0.66
			CONTR-LEG10: Regulations require me to periodically report on the safety of my dam as part of my dam management	4.54	0.84	0.71
IV2b		Voluntary diffusion	CONTR-VOL1: My neighbours and I manage our dams in a way that limits the impact of our farming operations, not because of any regulations	3.16	0.91	0.82
			CONTR-VOL2: There is no need for so much regulation as farmers around me do the right thing anyway	3.10	1.03	1.07
			CONTR-VOL3: I think the spillways of my dam are safe	2.71	0.71	0.51

IV3a	Content	Lack of decision making power	CONT-DEC1: The dam management regulations restrict me from storing water for my usual farming operations	4.60	0.90	0.80
			CONT-DEC2: I am limited by the laws that tell me how I must store my water in my dam	4.05	1.06	1.13
IV3b		Inconsistency with organisational goals	CONTE-CONS: The dam management regulations are not in line with the goals of this farm	4.00	0.99	0.97
IV4a	Constituents	Multiplicity	CONST-MULT: There are too many organisations putting pressure on me about my farm dam	4.15	1.21	1.48
IV4b		Dependence	CONST-DEP: I am dependent on government funding so that is why I comply with what the regulators want for my farm dam	4.99	0.74	0.54
IV4 Sub1		Industry groups	CONST-SUB1: My farming industry association guides me on the best way to manage my dam	4.28	1.01	1.01
IV4 Sub2		Banks and insurers	CONST-SUB2a: My insurance policy has a clause related to farm dams	4.51	0.79	0.63
			CONST-SUB2b: My bank requires info about my farm dam	4.81	0.75	0.56
IV4 Sub3		Community groups	CONST-SUB3: I attend local community meetings that discuss farm dam issues	4.21	1.04	1.09
IV4 Sub4		Environmental groups	CONST-SUB4: I discuss with local environmental groups, the best way to manage my dam	4.57	0.96	0.93
IV4 Sub5		Media	CONST-SUB5: I have changed my dam management practice because of an article in the media	5.00	0.54	0.29
IV5a	Cause	Social fitness	CAUS-SOC1: I comply with dam management regulations so I do not upset the farmers downstream	3.48	0.92	0.85
			CAUS-SOC2: I have had complaints about my dam management from neighbours	5.22	0.75	0.56
IV5b		Economic fitness	CAUS-ECO1: My annual budget includes an amount that allows me to check and ensure my spillway satisfies current safety standards	3.72	1.04	1.08
			CAUS-ECO2: My annual budget includes an amount that allows me to maintain the safety of my dam as part of my dam management	3.84	1.03	1.06

Appendix 4 - Tests of univariate normality: Skew and kurtosis of items, *z*-scores for outlier detection for continuous variables

Variable	Construct	**Measure** (Likert 1-7 scale)	Skew	Kurtosis	Min *z*-score all items	Max *z*-score all items
DV1	Acquiescence	ACQU1: I manage my dam in the same way we always have on this farm	0.85	1.90	-2.77	2.41
		ACQU2: I speak with others who work on the farm and adopt the best farm dam management approach used in the past	0.15	-1.20		
		ACQU3: I speak with others who work on the farm about the best farm dam management approach they currently recommend and adopt that approach	0.30	-0.81		
		ACQU4: I follow the dam management approach that is used by other successful farmers in the area	0.76	0.18		
		ACQU5: I make a conscious evaluation of specific dam laws and choose to comply with them	0.50	-0.49		
		ACQU6: I communicate with the regulators to determine the best way to comply with the spirit and intent of the dam management laws	-0.23	-0.93		
DV2	Compromise	COMP1: I negotiate openly with the regulators to obtain a mutually agreeable solution on management of my dam	0.01	-0.52	-3.17	2.73
		COMP2: I obtain consensus with the regulators about my farm dam management for the benefit of communities downstream	-0.31	-0.73		
		COMP3: I negotiate with the regulators to obtain an advantageous dam management situation for the community downstream	-0.76	-0.34		
		COMP4: I bargain with the regulators to obtain a favourable dam management situation for the community downstream	-0.51	0.42		
		COMP5: I partially conform with the specific dam management laws that are most important to the regulators	0.50	-0.15		
		COMP6: I determine the most important elements of dam management for regulators and agree to comply	0.62	0.10		
DV3	Avoidance	AVOID1: I appear to comply with dam management laws but intentionally avoid certain aspects of the requirements	-0.61	-0.12	-3.46	2.90
		AVOID2: I conceal certain aspects of my farm dam management from the regulators	-0.71	1.44		
		AVOID3: I purposefully block my spillway to build up my water supply	-0.29	2.94		
		AVOID4: I avoid in dealing with any industry bodies that are worried about dam management	-0.49	-0.36		
		AVOID5: I would consider moving spillway blockages to avoid detection by regulators	-0.26	1.51		
		AVOID6: I would consider growing intense vegetation near the dam to remove access to regulators	-0.82	3.82		
DV4	Defiance	DEFI1: I ignore the dam management regulations and just get on with my business	0.67	1.51	-2.97	1.92
		DEFI2: I ignore the dam management regulations and attempt to avoid any discussion with regulators	-0.32	-0.32		
		DEFI3: I would sue the regulator agency for overly burdensome dam management requirements	-0.69	0.46		
		DEFI4: I would challenge dam management requirements in court	-0.37	-0.50		
		DEFI5: I would challenge dam management requirements through the media	-0.53	-0.56		
		DEFI6: I would mount a campaign with the farmers around me and the community to attack the regulatory authority about dam management laws	-0.27	-0.84		
DV5	Manipulation	MANI1: I attempt to form an alliance with the regulators	-0.44	-0.18	-2.44	2.36

		regarding my dam management					
		MANI2: I attempt to include a regulator in my dam management decision making		-0.25	-0.56		
		MANI3: I attempt to influence public perceptions on how well I manage my dam		-0.59	-0.46		
		MANI4: I organise the farmers around me and the community to attempt to influence the dam management regulatory requirements		-0.89	1.033		
		MANI5: I meet with elected politicians to attempt to control the regulators on dam management issues		-0.79	0.81		
		MANI6: I attempt to deal with federal regulators to control the state and local government on dam management issues		-0.46	-0.52		
IV1a	Context	Environmental uncertainty	CONTX-ENV1: I am worried about the future of water availability to continue my farming operations	-0.16	-1.09	-2.84	2.86
			CONTX-ENV2: I block my spillway because of the uncertainty of future runoff in my region	-0.42	2.98		
IV1b		Inter-connectedness	CONTX-INTER1: Most of the farmers in my region manage their dams in the same way	0.42	2.37	-2.58	4.43
			CONTX-INTER2: I have worked with other farmers on dam management issues	-0.38	-1.15		
			CONTX-INTER3: The farmers around me share the water fairly	1.13	2.64		
IV2a	Control	Legal Coercion	CONTR-LEG1: I have received a notice from the regulator to change my dam management practice	-0.28	5.07	-3.53	2.34
			CONTR-LEG2: I am fearful of enforcement of dam management laws by regulators	-0.06	-0.77		
			CONTR-LEG3: The regional field officer periodically checks my dams	-0.65	0.62		
			CONTR-LEG4: I feel pressure from government about my dam management behaviour	-0.97	0.03		
			CONTR-LEG5: I am dependent on government for dam management information and education	-0.63	-0.41		
			CONTR-LEG6: The authority periodically checks my water meter	-0.58	0.66		
			CONTR-LEG7: The laws require me to provide too much water for the environment	-0.83	-0.24		
			CONTR-LEG8: The maximum storage capacity of my dam is checked periodically	-0.30	-1.01		
			CONTR-LEG9: Regulations require me to have an Emergency Action Plan for my dam as part of my dam management	-1.06	0.54		
			CONTR-LEG10: Regulations require me to periodically report on the safety of my dam as part of my dam management	-0.88	0.44		
IV2b		Voluntary diffusion	CONTR-VOL1: My neighbours and I manage our dams in a way that limits the impact of our farming operations, not because of any regulations	0.59	0.76	-2.40	2.04
			CONTR-VOL2: There is no need for so much regulation as farmers around me do the right thing anyway	0.53	0.43		
			CONTR-VOL3: I think the spillways of my dam are safe	-0.59	1.29		
IV3a	Content	Lack of	CONT-DEC1: The dam management	-1.24	1.45	-4.02	1.57

		decision making power	regulations restrict me from storing water for my usual farming operations				
			CONT-DEC2: I am limited by the laws that tell me how I must store my water in my dam	-0.27	-1.10		
IV3b		Consistency of organisational goals	CONTE-CONS: The dam management regulations are not in line with the goals of this farm	-0.46	-0.14	-3.03	2.03
IV4a	Constituents	Multiplicity	CONST-MULT: There are too many organisations putting pressure on me about my farm dam	-0.78	-0.38	2.59	1.52
IV4b		Dependence	CONST-DEP: I am dependent on government funding so that is why I comply with what the regulators want for my farm dam	-0.29	2.72	-2.70	2.73
IV4 Sub1		Industry groups	CONST-SUB1: My farming industry association guides me on the best way to manage my dam	-0.44	-0.63	-2.27	1.27
IV4 Sub2		Banks and insurers	CONST-SUB2a: My insurance policy has a clause related to farm dams	-0.73	0.86	-3.17	1.88
			CONST-SUB2b: My bank requires info about my farm dam	-1.36	3.98	-3.76	1.66
IV4 Sub3		Community groups	CONST-SUB3: I attend local community meetings that discuss farm dam issues	-0.29	-1.23	-2.12	1.71
IV4 Sub4		Environmental groups	CONST-SUB4: I discuss with local environmental groups, the best way to manage my dam	-0.95	0.52	-2.67	1.48
IV4 Sub5		Media	CONST-SUB5: I have changed my dam management practice because of an article in the media	-0.75	8.23	-3.71	3.67
IV5a	Cause	Social fitness	CAUS-SOC1: I comply with dam management regulations so I do not upset the farmers downstream	0.23	-0.04	-2.75	2.73
			CAUS-SOC2: I have had complaints about my dam management from neighbours	-0.09	3.52		
IV5b		Economic fitness	CAUS-ECO1: My annual budget includes an amount that allows me to check and ensure my spillway satisfies current safety standards	0.43	-0.96	-1.65	2.20
			CAUS-ECO2: My annual budget includes an amount that allows me to maintain the safety of my dam as part of my dam management	0.12	-0.81		

Appendix 5 – Exploratory factor analysis inter-item correlations and communalities

Variable	Observed Variable (Likert 1-7 scale)	Correlations					Communalities	
		ACQU2	**ACQU3**	**ACQU4**	**ACQU5**	**ACQU6**	**Initial**	**Extracted**
Acquiescence	ACQU1: I manage my dam in the same way we always have on this farm	0.12	0.01	0.10	0.05	-0.08	0.04	0.03
	ACQU2: I speak with others who work on the farm and adopt the best farm dam management approach used in the past		0.53	0.29	0.16	0.12	0.31	0.61
	ACQU3: I speak with others who work on the farm about the best farm dam management approach they currently recommend and adopt that approach			0.29	0.18	0.20	0.32	0.46
	ACQU4: I follow the dam management approach that is used by other successful farmers in the area				0.07	0.14	0.13	0.17
	ACQU5: I make a conscious evaluation of specific dam laws and choose to comply with them					0.32	0.12	0.17
	ACQU6: I communicate with the regulators to determine the best way to comply with the spirit and intent of the dam management laws					1.00	0.14	0.62
		COMP2	**COMP3**	**COMP4**	**COMP5**	**COMP6**	**Initial**	**Extracted**
Compromise	COMP1: I negotiate openly with the regulators to obtain a mutually agreeable solution on management of my dam	0.48	0.47	0.26	0.28	0.26	0.34	0.43
	COMP2: I obtain consensus with the regulators about my farm dam management for the benefit of communities downstream		0.41	0.37	0.20	0.30	0.33	0.43
	COMP3: I negotiate with the regulators to obtain an advantageous dam management situation for the community downstream			0.41	0.25	0.26	0.33	0.45
	COMP4: I bargain with the regulators to obtain a favourable dam management situation for the community downstream				0.17	0.24	0.22	0.26
	COMP5: I partially conform with the specific dam management laws that are most important to the regulators					0.35	0.17	0.17
	COMP6: I determine the most important elements of dam management for regulators and agree to comply					1.00	0.20	0.21
		AVOI2	**AVOI3**	**AVOI4**	**AVOI5**	**AVOI6**	**Initial**	**Extracted**
Avoidance	AVOID1: I appear to comply with dam management laws but intentionally avoid certain aspects of the requirements	0.24	0.13	0.24	0.14	0.12	0.11	0.34
	AVOID2: I conceal certain aspects of my farm dam management from the regulators		0.29	0.07	0.23	0.28	0.18	0.30
	AVOID3: I purposefully block my spillway to build up my water supply			0.04	0.29	0.23	0.16	0.35
	AVOID4: I avoid in dealing with any industry bodies that are worried about dam management				0.09	0.14	0.07	0.17
	AVOID5: I would consider moving spillway blockages to avoid detection by regulators					0.17	0.12	0.20
	AVOID6: I would consider growing intense vegetation near the dam to remove access to regulators					1.00	0.12	0.19
		DEFI2	**DEFI3**	**DEFI4**	**DEFI5**	**DEFI6**	**Initial**	**Extracted**
Defiance	DEFI1: I ignore the dam management regulations and just get on with my business	0.30	0.02	-0.02	-0.02	0.02	0.10	0.23
	DEFI2: I ignore the dam management regulations and attempt to avoid any discussion with regulators		0.20	0.15	0.22	0.22	0.17	0.47
	DEFI3: I would sue the regulator agency for overly burdensome dam management requirements			0.52	0.39	0.48	0.37	0.51
	DEFI4: I would challenge dam management requirements in court				0.40	0.41	0.33	0.45
	DEFI5: I would challenge dam management requirements through the media					0.44	0.28	0.37
	DEFI6: I would mount a campaign with the farmers around me and the community to attack the regulatory authority about dam management laws					1.00	0.33	0.45

			MANI2	MANI3	MANI4	MANI5	MANI6	Initial	Extracted
Manipulation	MANI1: I attempt to form an alliance with the regulators regarding my dam management		0.42	0.29	0.28	0.26	0.33	0.28	0.39
	MANI2: I attempt to include a regulator in my dam management decision making			0.17	0.16	0.23	0.29	0.22	0.24
	MANI3: I attempt to influence public perceptions on how well I manage my dam				0.28	0.22	0.16	0.13	0.18
	MANI4: I organise the farmers around me and the community to attempt to influence the dam management regulatory requirements					0.42	0.32	0.27	0.32
	MANI5: I meet with elected politicians to attempt to control the regulators on dam management issues						0.22	0.22	0.27
	MANI6: I attempt to deal with federal regulators to control the state and local government on dam management issues						1.00	0.19	0.26
			CONXENV2					**Initial**	**Extracted**
Context	Environmental uncertainty	CONTX-ENV1: I am worried about the future of water availability to continue my farming operations	0.06					0.04	0.06
		CONTX-ENV2: I block my spillway because of the uncertainty of future runoff in my region	1.00					0.04	0.06
			CONXINTER2	**CONX INTER3**				**Initial**	**Extracted**
	Interconnectedness	CONTX-INTER1: Most of the farmers in my region manage their dams in the same way	0.18	0.30				0.11	0.42
		CONTX-INTER2: I have worked with other farmers on dam management issues		0.12				0.04	0.07
		CONTX-INTER3: The farmers around me share the water fairly		1.00				0.09	0.21
			LEG2	**LEG3**	**LEG4**	**LEG5**	**LEG6**	**LEG7**	**LEG 8**	**LEG9**	**LEG10**	**Initial**	**Extracted**
Control	Legal Coercion	CONTR-LEG1: I have received a notice from the regulator to change my dam management practice	0.03	0.17	0.20	0.03	0.02	0.06	-0.08	-0.01	0.13	0.09	0.29
		CONTR-LEG2: I am fearful of enforcement of dam management laws by regulators		0.02	0.35	0.09	0.05	0.27	0.16	0.06	0.02	0.18	0.40
		CONTR-LEG3: The regional field officer periodically checks my dams			0.14	0.13	0.43	-0.03	0.29	0.24	0.34	0.31	0.72
		CONTR-LEG4: I feel pressure from government about my dam management behaviour				0.09	0.09	0.32	0.10	0.14	0.13	0.24	0.48
		CONTR-LEG5: I am dependent on government for dam management information and education					0.09	-0.13	0.07	0.08	0.08	0.06	0.04
		CONTR-LEG6: The authority periodically checks my water meter						0.01	0.21	0.23	0.21	0.21	0.28
		CONTR-LEG7: The laws require me to provide too much water for the environment							0.04	0.04	0.03	0.16	0.23
		CONTR-LEG8: The maximum storage capacity of my dam is checked periodically								0.23	0.024	0.15	0.21
		CONTR-LEG9: Regulations require me to have an Emergency Action Plan for my dam as part of my dam management									0.39	0.20	0.39
		CONTR-LEG10: Regulations require me to periodically report on the safety of my dam as part of my dam management									1.00	0.23	0.45
			CONRVOL2	**CONRVOL3**								**Initial**	**Extracted**
	Voluntary diffusion	CONTR-VOL1: My neighbours and I manage our dams in a way that limits the impact of our farming operations, not because of any regulations	0.18	0.18								0.06	0.25
		CONTR-VOL2: There is no need for so much regulation as farmers around me do		0.13								0.04	0.13

		the right thing anyway			
		CONTR-VOL3: I think the spillways of my dam are safe	1.00	0.04	0.13
			CONTDEC2	**Initial**	**Extracted**
Content	Decision making power	CONT-DEC1: The dam management regulations restrict me from storing water for my usual farming operations	0.21	0.05	0.21
		CONT-DEC2: I am limited by the laws that tell me how I must store my water in my dam	1.00	0.05	0.21
	Consistency of organisational goals	CONTE-CONS: The dam management regulations are not in line with the goals of this farm	Single item measures		
Constituents	Multiplicity	CONST-MULT: There are too many organisations putting pressure on me about my farm dam			
	Dependence	CONST-DEP: I am dependent on government funding so that is why I comply with what the regulators want for my farm dam			
	Industry groups	CONST-SUB1: My farming industry association guides me on the best way to manage my dam			
	Banks and insurers	CONST-SUB2a: My insurance policy has a clause related to farm dams			
		CONST-SUB2b: My bank requires info about my farm dam			
	Community groups	CONST-SUB3: I attend local community meetings that discuss farm dam issues			
	Environmental groups	CONST-SUB4: I discuss with local environmental groups, the best way to manage my dam			
	Media	CONST-SUB5: I have changed my dam management practice because of an article in the media			
			CAUSSOC2	**Initial**	**Extracted**
Cause	Social fitness	CAUS-SOC1: I comply with dam management regulations so I do not upset the farmers downstream	-0.14	0.02	0.14
		CAUS-SOC2: I have had complaints about my dam management from neighbours	1.00	0.02	0.14
			CASUECO2	**Initial**	**Extracted**
	Economic fitness	CAUS-ECO1: My annual budget includes an amount that allows me to check and ensure my spillway satisfies current safety standards	0.53	0.28	0.53
		CAUS-ECO2: My annual budget includes an amount that allows me to maintain the safety of my dam as part of my dam management	1.00	0.28	0.53

Appendix 6 – Mahalanobis Distance values

Participant	Mahabanoblis Distance	Participant	Mahabanoblis Distance	Participant	Mahabanoblis Distance
1	30.03963	33	11.51136	65	35.14824
2	9.64541	34	8.83638	66	47.05247
3	22.41351	35	20.90395	67	15.00201
4	11.38835	36	14.54772	68	28.70517
5	18.98014	37	28.59781	69	42.79808
6	25.02095	38	22.84277	70	13.93500
7	39.26366	39	25.49344	71	41.23052
8	15.62008	40	17.98822	72	56.98052
9	19.55071	41	10.48212	73	30.01207
10	45.22627	42	12.13407	74	33.17213
11	8.36138	43	23.71663	75	11.85278
12	33.14945	44	12.95292	76	4.93377
13	10.74450	45	24.95146	77	14.21971
14	10.45893	46	26.10192	78	12.82554
15	14.08764	47	14.20194	79	10.41967
16	10.92416	48	20.03502	80	6.85546
17	35.01393	49	15.86463	81	22.71734
18	39.23814	50	26.71357	82	29.17971
19	13.68777	51	18.36082	83	14.08120
20	9.98263	52	26.35328	84	9.75336
21	25.88028	53	59.80959	85	12.45473
22	12.37696	54	13.11349	86	44.89346
23	28.13813	55	20.53314	87	14.92011
24	16.16306	56	21.57788	88	7.16614
25	12.70583	57	49.11554	89	13.46297
26	15.86171	58	28.06677	90	7.25550
27	9.96249	59	35.33378	91	9.37151
28	41.82041	60	62.46980	92	13.88438
29	34.96771	61	49.33623	93	17.82720
30	32.29003	62	47.89562	94	15.79076
31	11.12860	63	23.12514	95	13.81878
32	18.52084	64	13.84643	96	15.95987

Participant	Mahabanoblis Distance	Participant	Mahabanoblis Distance	Participant	Mahabanoblis Distance
97	11.45491	129	6.27421	161	21.27971
98	29.16088	130	57.05777	162	23.53797
99	17.29713	131	13.71110	163	17.64083
100	8.66103	132	23.83733	164	5.50244
101	31.59470	133	12.03645	165	50.66885
102	10.91779	134	28.09905	166	10.37463
103	23.45549	135	17.17109	167	15.12870
104	19.31007	136	28.99480	168	16.60459
105	18.53385	137	49.85232	169	17.43623
106	24.22548	138	17.87564	170	16.80959
107	37.42511	139	15.32857	171	11.85840
108	5.38034	140	8.02355	172	14.14322
109	12.10232	141	27.97459	173	14.38428
110	40.47011	142	16.05634	174	6.25054
11	19.72150	143	8.75138	175	56.82654
112	8.74446	144	35.66971	176	12.83558
113	11.69657	145	18.94916	177	11.21604
114	13.36126	146	20.68051	178	16.60637
115	58.65669	147	11.32455	179	16.92446
116	35.69942	148	24.22576	180	6.95888
117	27.54712	149	55.06457	181	25.10403
118	26.98756	150	23.65507	182	21.36743
119	12.32608	151	12.78081	183	20.46202
120	53.12919	152	57.07913	184	6.07628
121	36.92057	153	16.57102	185	11.85579
122	19.05723	154	21.69091	186	28.51670
123	20.08065	155	54.44779	187	10.90090
124	20.43725	156	4.59837	188	4.15689
125	24.35676	157	15.43229	189	31.04374
126	21.71153	158	47.07593	190	13.86042
127	4.82474	159	17.25989	191	20.91443
128	45.62649	160	31.53427	192	22.17054

Participant	Mahabanoblis Distance	Participant	Mahabanoblis Distance	Participant	Mahabanoblis Distance
193	13.72650	225	38.44431	257	39.49134
194	14.78993	226	34.34219	258	14.57781
195	13.59058	227	22.08349	259	47.62998
196	60.27794	228	54.77656	260	40.55036
197	39.27788	229	32.14217	261	27.25274
198	44.32622	230	56.42834	262	26.40876
199	15.55238	231	34.56581	263	47.66684
200	22.60678	232	29.79689	264	38.14664
201	17.67319	233	22.80940	265	41.66159
202	31.70270	234	73.97082	266	49.21035
203	14.20565	235	44.09892	267	75.37494
204	31.74002	236	46.82989	268	38.38782
205	93.55166	237	65.11918	269	32.18002
206	77.62434	238	32.54811	270	44.73397
207	43.47242	239	38.11039	271	24.97614
208	56.45545	240	32.56492	272	58.74628
209	146.45704	241	108.31556	273	73.33372
210	58.03944	242	50.32344	274	94.83222
211	35.20206	243	50.76224	275	20.21522
212	48.94706	244	62.34791	276	24.50610
213	35.83982	245	32.50528	277	63.52818
214	54.23438	246	46.74527	278	54.11356
215	83.37289	247	19.06877	279	37.68272
216	25.59307	248	38.92761	280	20.95623
217	84.87397	249	37.38419	281	31.13386
218	58.89774	250	94.87673	282	29.30776
219	36.64277	251	45.03800	283	64.68678
220	70.58072	252	27.17640	284	72.89974
221	55.34032	253	35.58213	285	71.50119
222	35.62373	254	94.17808	286	20.00673
223	36.96047	255	70.41921	287	56.07350
224	35.53269	256	25.18915	288	23.91131

Participant	Mahabanoblis Distance	Participant	Mahabanoblis Distance	Participant	Mahabanoblis Distance
289	37.63300	321	15.21024	353	35.60926
290	27.66971	322	91.38705	354	89.20165
291	23.23002	323	35.58161	355	20.04094
292	46.11400	324	35.22104	356	55.07256
293	37.64606	325	35.68076	357	21.84786
294	37.36486	326	40.99244	358	33.33927
295	76.13892	327	33.86093	359	33.03124
296	67.57642	328	22.44779	360	29.44922
297	32.83769	329	18.32199	361	40.92379
298	36.98843	330	21.32113	362	25.85758
299	27.75433	331	15.24246	363	23.19504
300	38.06992	332	46.54833	364	74.21666
301	25.06058	333	151.09979	365	63.11870
302	30.01517	334	40.82033	366	42.56501
303	51.96427	335	30.25084	367	49.58226
304	65.11918	336	108.21467	368	65.46302
305	103.42883	337	23.23345	369	53.05333
306	58.59903	338	60.80541	370	54.74956
307	63.06278	339	25.07922	371	33.67133
308	132.52200	340	81.58145	372	47.75332
309	37.54323	341	33.73718	373	82.27466
310	35.76203	342	18.35010	374	65.50970
311	28.98252	343	50.50502	375	21.60046
312	31.06010	344	92.22263	376	86.07884
313	39.78111	345	48.49994	377	94.87701
314	56.55544	346	52.42786	378	50.69268
315	82.84844	347	30.99414	379	30.21180
316	27.47338	348	23.75454	380	57.21012
317	46.30302	349	130.48486	381	19.82395
318	40.94073	350	35.07237	382	31.26878
319	21.52886	351	28.47750	383	24.99912
320	58.74408	352	23.36428	384	24.51204

Participant	Mahabanoblis Distance
385	66.50727
386	54.77567
387	17.04085
388	34.50858
389	49.27512
390	79.23084
391	61.06203
392	21.90657
393	40.26603
394	47.95559
395	74.02849
396	57.83878
397	55.61893
398	54.81531
399	17.89342
400	43.03269
401	23.35958
402	39.91730
403	19.73846
404	55.96858

Appendix 6 – Variable Correlation Analysis Matrix – Pearson's *r*

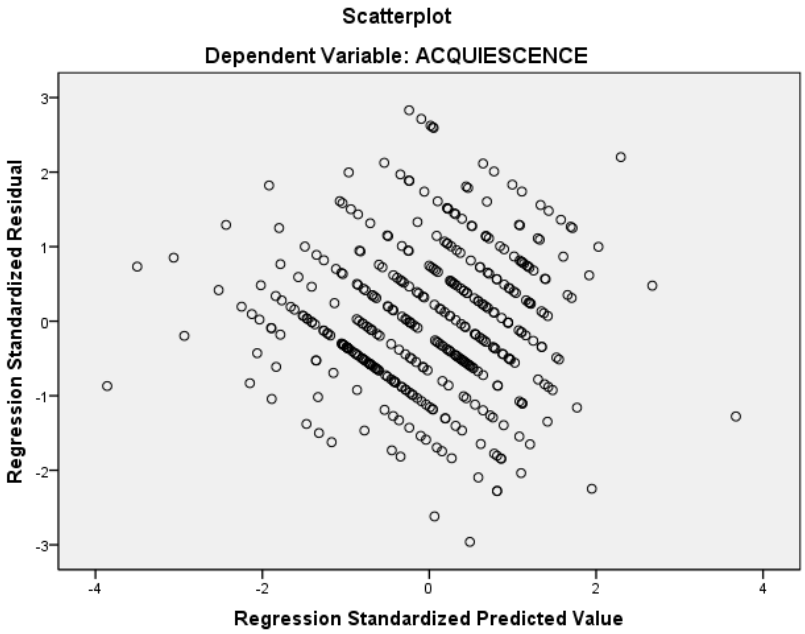
** = sig.@0.05, **=sig.@0.001*

	ACQUIESCENCE (DV)	COMPROMISE (DV)	AVOIDANCE (DV)	DEFIANCE (DV)	MANIPULATION (DV)	ENVIRONMENTAL UNCERTAINTY (IV1a)	INTERCONNECTED-NESS (IV1b)	LEGAL COERCION-ACTION (IV2a(i))	LEGAL COERCION-THREAT (IV2a(ii))	VOLUNTARY DIFFUSION (IV2b)	DECISION POWER (IV3a)	CONSISTENCY WITH GOALS (IV3b)	MULTIPLICITY (IV4a)	DEPENDENCY (IV4b)	INDUSTRY BODY (IV4Sub1)	INSURANCE (IV4Sub2)	BANK (IV4Sub3)	COMMUNITY GROUP (IV4Sub4)	ENVIRONMENTAL GROUP (IV4Sub5)	MEDIA (IV4Sub6)	SOCIAL FITNESS (IV5a)	ECONOMIC FITNESS (IV5b)	INSTITUTIONAL ENVIRONMENT(ModV)	ENVIRONMENTAL UNCERTAINTY*ModV	INTERCONNECT-EDNESS*ModV	LEGAL COERCION-ACTION*ModV	LEGAL COERCION-THREAT*ModV	VOLUNTARY DIFFUSION *ModV	DECISION POWER*ModV	CONSISTENCY WITH GOALS*ModV	MULTIPLICITY*ModV	DEPENDENCY*ModV	INDUSTRY BODY*ModV	INSURANCE*ModV	BANK*ModV	COMMUNITY GROUP*ModV	ENVIRONMENTAL GROUP*ModV	MEDIA*ModV	SOCIAL FITNESS*ModV
COMPROMISE (DV)	0.43**																																						
AVOIDANCE (DV)	0.04	0.11*																																					
DEFIANCE (DV)	0.14**	0.06	0.13**																																				
MANIPULATION (DV)	0.34**	0.59**	0.25**	0.19**																																			
ENVIRONMENTAL UNCERTAINTY (IV1a)	0.21**	0.22**	0.08**	0.32**	0.26**																																		
INTERCONNECT-EDNESS (IV1b)	0.27**	0.10*	-0.05	0.13**	0.08	0.08*																																	
LEGAL COERCION-ACTION (IV2a(i))	0.29**	0.05**	0.09*	0.10*	0.48**	0.14**	0.01																																
LEGAL COERCION-THREAT (IV2a(ii))	0.25**	0.13**	0.19**	0.47**	0.24**	0.44**	0.18**	0.14**																															
VOLUNTARY DIFFUSION (IV2b)	0.34**	0.08	-0.15**	0.17**	0.03	0.16**	0.41**	0.10*	0.34**																														
DECISION POWER (IV3a)	0.26**	0.30**	0.23**	0.18**	0.32**	0.37**	0.09*	0.21**	0.35**	0.05																													
CONSISTENCY WITH GOALS (IV3b)	0.01	-0.08	0.04	0.34**	-0.06	0.14**	0.13**	-0.07	0.39**	0.23**	0.24**																												
MULTIPLICITY (IV4a)	0.22**	0.08	0.13**	0.32**	0.14*	0.28**	0.17**	0.14**	0.54**	0.25**	0.27**	0.31**																											
DEPENDENCY (IV4b)	0.08	0.14**	0.39**	-0.03	0.21**	0.08	-0.06	0.08	0.04	-0.14**	0.15**	-0.07	0.02																										
INDUSTRY BODY (IV4Sub1)	0.36**	0.34**	0.22**	0.08	0.43**	0.15**	0.13**	0.21**	0.15**	0.04	0.20**	-0.03	0.12**	0.15**																									
INSURANCE (IV4Sub2)	0.12*	0.15**	0.09*	0.06	0.20**	0.12**	-0.03	0.25**	0.18**	-0.04	0.09*	0.05	0.11*	0.05	0.22**																								
BANK (IV4Sub3)	0.18**	0.29**	0.15**	0.03	0.27**	0.16**	0.00	0.37**	0.09*	0.03	0.20**	0.03	0.12**	0.15**	0.20**	0.21**																							
COMMUNITY GROUP (IV4Sub4)	0.31**	0.27**	0.17**	0.19**	0.45**	0.18**	-0.01	0.28**	0.23	0.02	0.22**	-0.01	0.21**	0.08*	0.30**	0.18**	0.19**																						
ENVIRONMENTAL GROUP (IV4Sub5)	0.22**	0.33**	0.10*	0.062	0.43**	0.16**	0.05	0.26**	0.07	-0.02	0.13**	-0.06	0.09*	0.17**	0.29**	0.13**	0.16**	0.16**																					
MEDIA (IV4Sub6)	0.02	0.10*	0.31**	-0.04	0.17**	0.02	-0.07	0.07	0.02	-0.17**	0.07	-0.07	-0.01	0.20**	0.10*	0.10*	0.21**	0.11*	0.12**																				
SOCIAL FITNESS (IV5a)	0.35**	0.37**	-0.3	0.14**	0.21**	0.15**	0.22	0.20**	0.11*	0.26**	0.21**	0.02	0.17**	-0.02	0.20**	0.01	0.13**	0.21**	0.14**	0.04																			
ECONOMIC FITNESS (IV5b)	0.39**	0.40**	0.14**	0.09*	0.34**	0.16**	0.07	0.44**	0.17**	0.20**	0.18**	-0.10*	0.12**	0.11*	0.29**	0.21**	0.22**	0.18**	0.19**	0.13**	0.21**																		
INSTITUTIONAL ENVIRONMENT (ModV)	0.04	-0.13**	-0.06	0.07	0.01	0.14**	0.03	-0.19**	0.14**	0.01	-0.02	0.06	0.08	0.09*	0.04	-0.02	-0.13**	0.10*	0.05	0.05	-0.02	-0.10*																	
ENVIRONMENTAL UNCERTAINTY*ModV	-0.07	0.03	0.02	-0.01	0.02	-0.02	-0.01	0.01	-0.09*	-0.0.4	0.04	0.05	-0.04	0.06	-0.01	-0.06	-0.02	0.02	-0.05	0.08	-0.06	0.03	0.04															
INTERCONNECT-EDNESS*ModV	-0.06	0.00	-0.02	-0.03	-0.00	-0.02	-0.05	0.04	-0.09*	-0.08	-0.03	-0.03	-0.05	0.07	-0.03	0.02	-0.01	-0.04	-0.02	0.07	-0.07	-0.02	-0.01	0.14**														
LEGAL COERCION-ACTION*ModV	0.10*	0.09	-0.04	0.01	0.06	0.01	0.03	0.14**	0.03	0.03	-0.09*	0.04	0.08	-0.05	0.02	0.02	0.13**	0.12*	-0.03	0.02	0.09*	0.08	-0.03	0.17**	0.14**													
LEGAL COERCION-THREAT*ModV	0.01	0.02	0.00	-0.05	0.02	-0.09*	-0.08	0.03	-0.13**	-0.05	-0.02	0.07	-- 0.12**	0.03	-0.01	-0.02	-0.01	-0.03	0.03	0.00	-0.08	-0.03	-0.03	0.42**	0.27**	0.10*												
VOLUNTARY DIFFUSION*ModV	0.03	0.04	-0.06	-0.04	-0.01	-0.04	-0.07	0.03	-0.05	0.14**	-0.04	0.04	-0.04	-0.03	-0.01	-0.01	-0.01	0.05	0.02	-0.02	-0.04	0.04	0.04	0.22*	0.31**	0.13**	0.44**										
DECISION POWER*ModV	-0.03	-0.03	-0.04	0.03	-0.04	0.05	-0.03	-0.09*	-0.02	-0.04	0.03	0.09*	-0.05	0.04	-0.05	-0.03	0.01	-0.02	-0.04	-0.04	-0.06	-0.90*	-0.02	0.41**	0.15**	0.21**	0.30**	0.08									
CONSISTENCY WITH GOALS*ModV	0.00	0.03	0.03	0.01	0.01	0.05	-0.02	0.04	0.07	0.04	0.08	0.09*	0.07	0.06	-0.04	-0.06	0.01	-0.02	0.02	-0.06	-0.07	-0.01	-0.02	0.23**	0.16**	-0.08	0.44**	0.31**	0.27**								
MULTIPLICITY*ModV	0.02	0.06	0.03	-0.03	-0.04	-0.04	-0.04	0.07	-0.12**	-0.04	-0.04	0.07	-0.03	0.08	0.06	-0.04	0.07	0.02	0.06	0.06	0.02	0.05	-0.02	0.34**	0.26**	0.14**	0.58**	0.34**	0.24**	0.33**							
DEPENDENCY*ModV	0.06	0.03	0.02	0.09*	0.02	0.06	0.06	-0.05	0.03	-0.03	0.04	0.06	0.08*	0.07	0.04	0.03	0.05	-0.01	0.10*	0.08	0.09	0.04	-0.03	0.10*	-0.01	0.07	0.02	-0.15**	0.11*	-0.09*	0.06						
INDUSTRY BODY*ModV	0.01	0.00	0.03	0.05	0.01	-0.01	-0.03	0.02	-0.01	-0.01	-0.05	-0.04	0.07	0.04	-0.04	-0.02	0.11*	0.00	0.01	0.01	0.01	0.01	-0.02	0.15**	0.14**	0.20**	0.14**	0.05	0.17**	-0.06	0.19**	0.16**					
INSURANCE*ModV	-0.03	-0.03	-0.03	-0.09*	-0.06	-0.06	0.02	0.002	-0.02	-0.01	-0.03	-0.06	-0.04	0.03	-0.02	0.15**	0.04	-0.04	-0.02	0.03	-0.05	-0.01	-0.07	0.08	0.09*	0.21**	0.15**	-0.02	0.06	0.04	0.03	0.06	0.10*				
BANK*ModV	0.10*	0.11*	-0.10*	-0.01	-0.02	-0.02	-0.01	0.12**	-0.01	0.01	0.01	0.01	0.07	0.05	0.01*	0.04	0.40**	0.08*	0.02	-0.03	0.09*	0.04	-0.11*	0.21**	0.06	0.29**	0.10*	0.10*	0.23**	0.06	0.18**	0.16**	0.18**	0.18**			
COMMUNITY GROUP*ModV	0.11*	0.08	-0.01	-0.02	0.02	0.02	-0.04	0.11*	-0.03	0.05	-0.02	-0.02	0.02	-0.01	0.00	-0.04	0.09*	0.03	-0.01	-0.02	0.08*	0.06	-0.12**	0.17**	0.02	0.27**	0.19**	0.04	0.14**	0.02	0.23**	0.05	0.31**	0.13**	0.17**		
ENVIRONMENTAL GROUP*ModV	-0.02	-0.05	0.11	0.05	-0.05	-0.05	-0.02	-0.03	0.03	0.02	-0.04	0.02	0.06	0.10*	0.01	-0.02	0.02	-0.01	-0.03	0.06	-0.04	0.03	-0.03	0.16**	0.04	0.24**	0.05	-0.01	0.07	-0.12**	0.06	0.16**	0.36**	0.20**	0.1*	0.20**	
MEDIA*ModV	-0.07	0.01	0.02	-0.05	0.09*	0.09*	0.06	0.02	0.00	-0.02	-0.05	-0.07	0.07	0.09*	0.02	0.03	-0.03	-0.02	0.06	-0.11*	-0.01	-0.04	-0.01	-0.03	-0.10*	-0.04	-0.04	-0.20**	0.07	-0.04	-0.05	0.18**	0.09*	0.11*	0.09*	0.05	0.08*	
SOCIAL FITNESS*ModV	0.03	0.06	-0.02	-0.03	-0.06	-0.06	-0.06	0.09*	-0.08	-0.04	0-0.06	-0.07	0.02	0.08*	0.01	-0.05	0.20*	0.08	-0.04	-0.01	0.01	-0.03	-0.01	0.12**	0.20**	0.33**	0.12**	0.18**	0.28**	-0.03	0.18**	0.06	0.16**	-0.02	0.18**	0.25**	0.14**	0.04	
ECONOMIC FITNESS *ModV	-0.02	0.05	0.01	-0.05	0.025	0.03	-0.02	0.08	-0.04	0.04	-0.09	-0.02	0.06	0.04	0.01	-0.01	0.04	0.07	0.03	-0.04	-0.03	0.01	-0.10*	0.13**	0.09*	0.39**	0.12*	0.18**	0.15**	0.07	0.19**	0.10*	0.25**	0.19**	0.19**	0.16**	0.15**	0.11*	0.25**

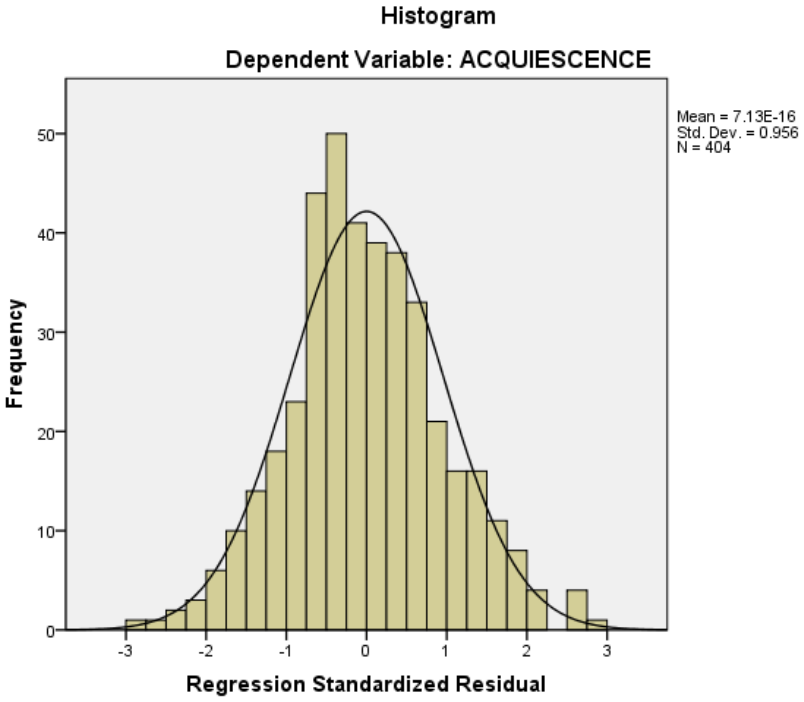
Appendix 8 – Linearity, normality and heteroscedasticity of residuals

Figure 1 – Acquiescence regression equation residuals

(a) Standardised residual plot



(b) Histogram of residuals



(c) Normal P-P plot of residual distribution

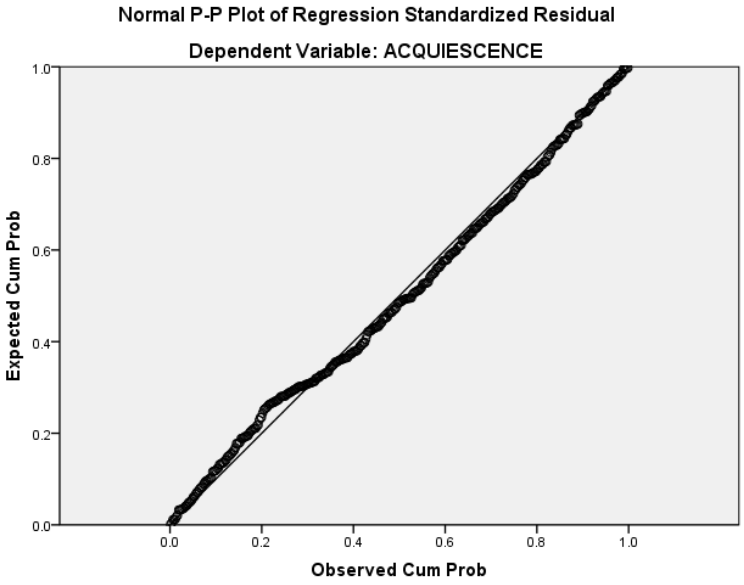
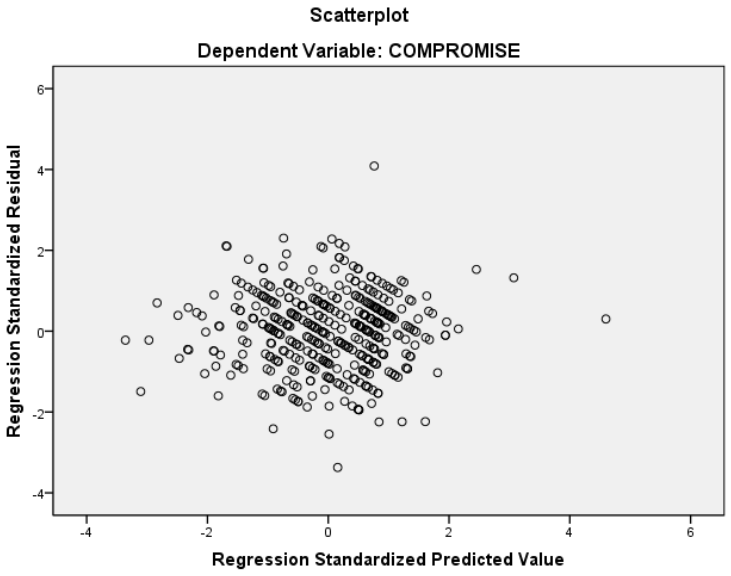
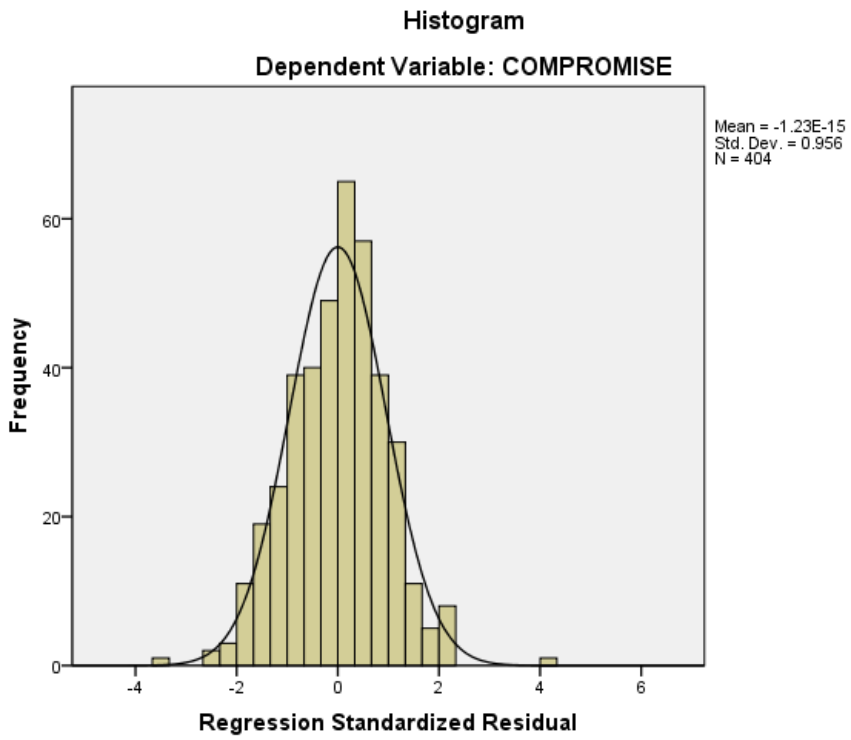


Figure 2 – Compromise regression equation residuals

(a) Standardised residual plot



(b) Histogram of residuals



(c) Normal P-P plot of residual distribution

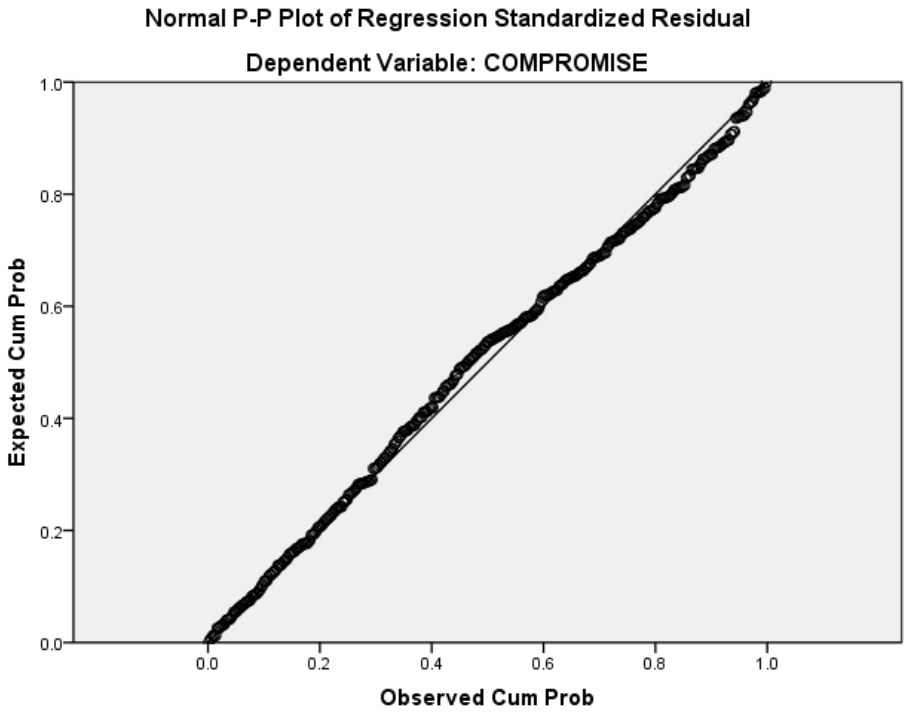
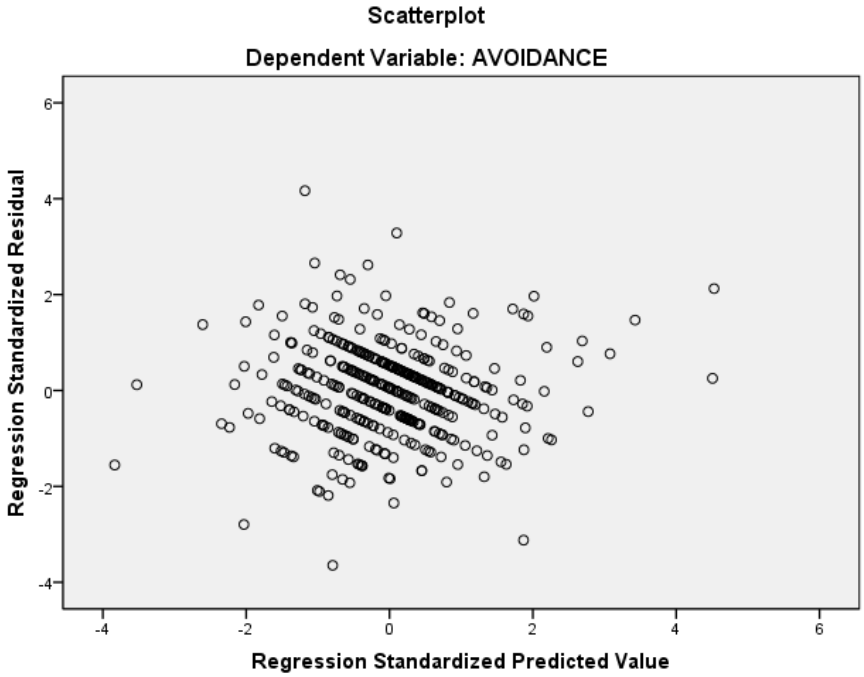
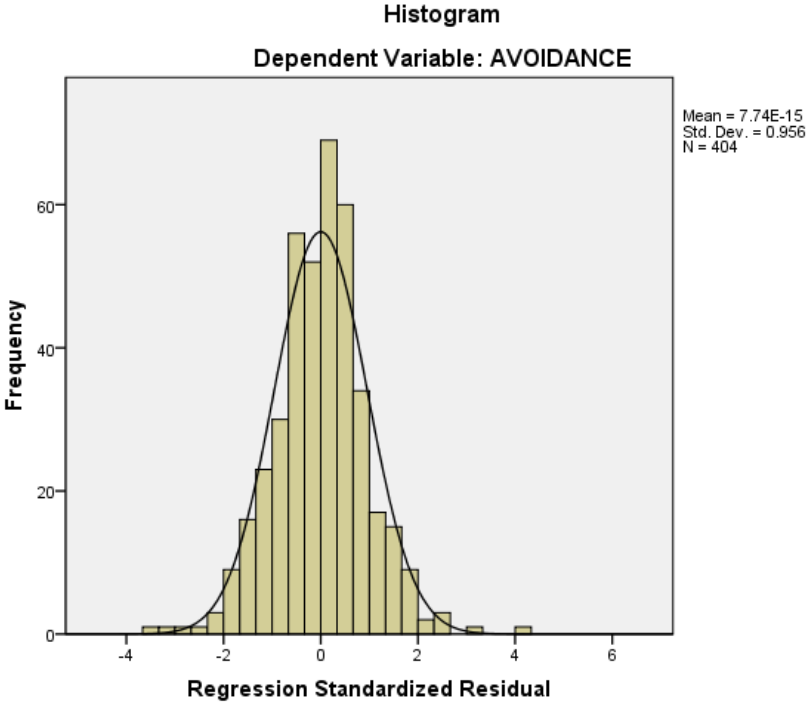


Figure 3 – Avoidance regression equation residuals

(a) Standardised residual plot



(b) Histogram of residuals



(c) Normal P-P plot of residual distribution

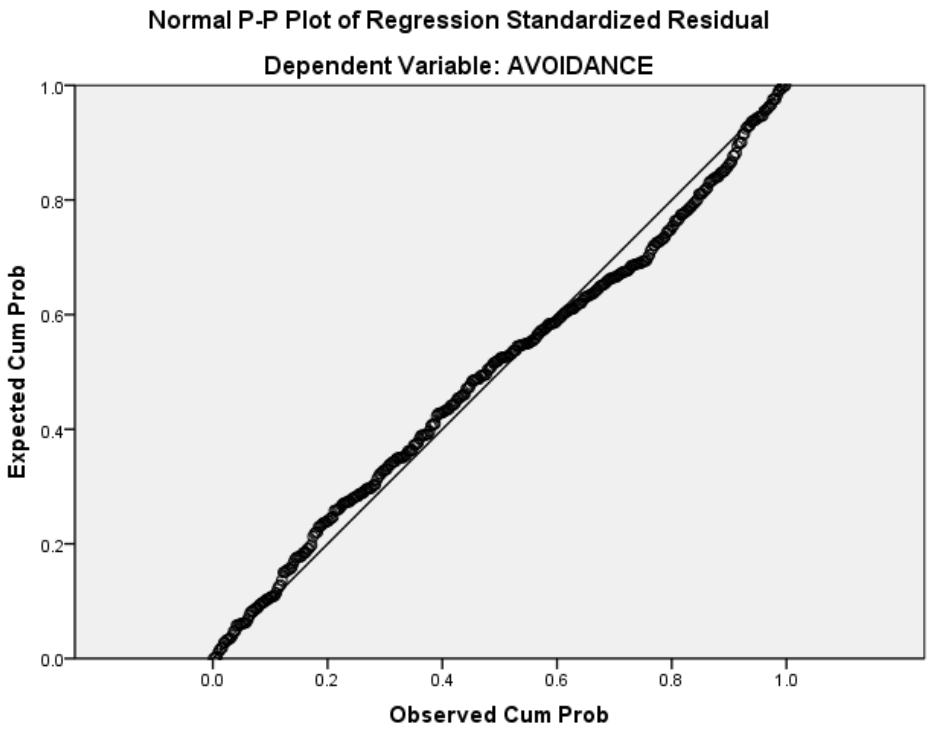
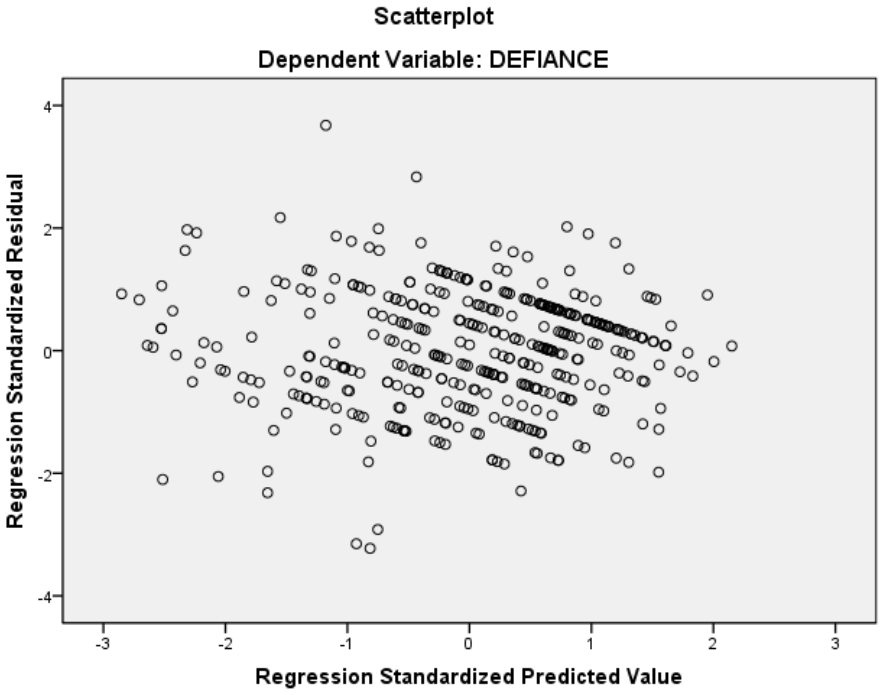
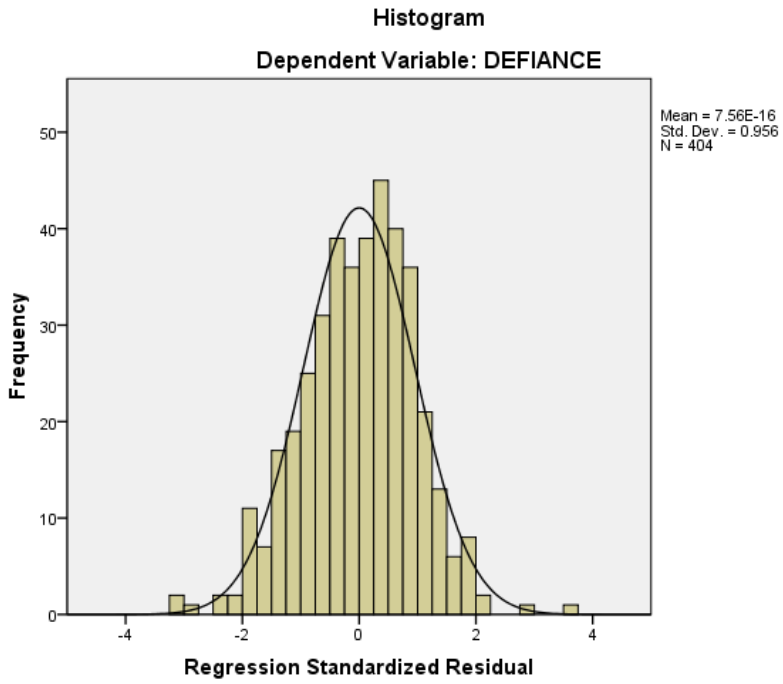


Figure 4 – Defiance regression equation residuals

(a) Standardised residual plot



(b) Histogram of residuals



(c) Normal P-P plot of residual distribution

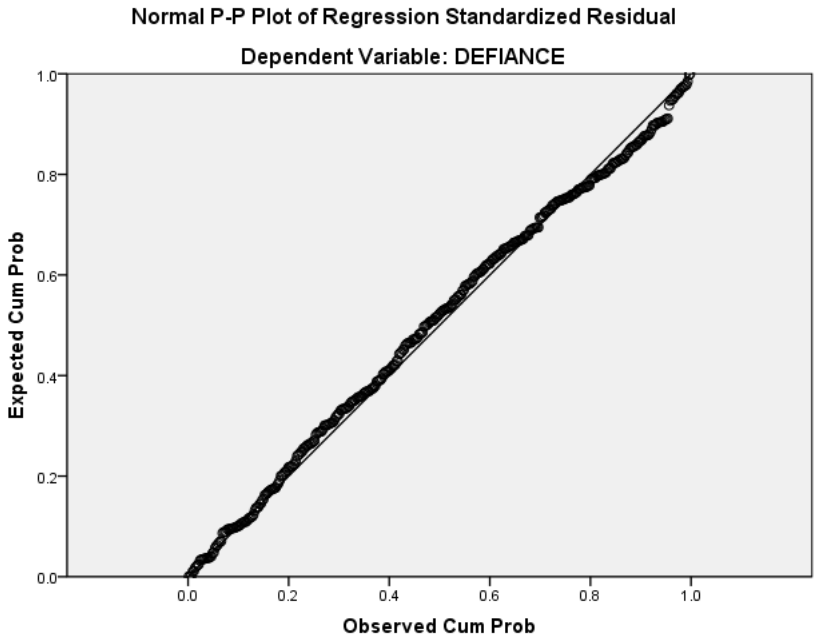
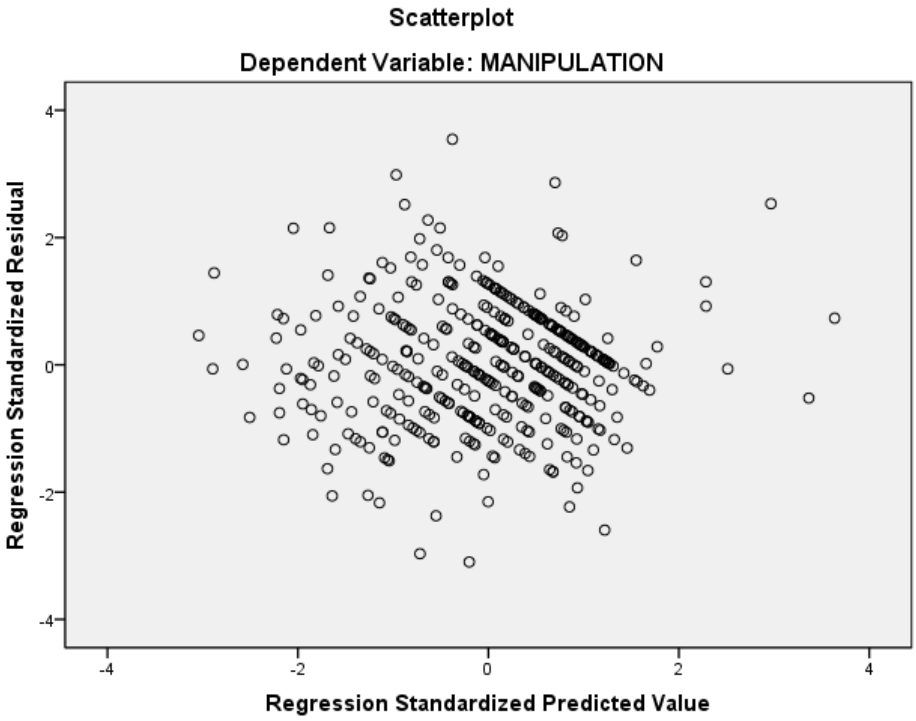
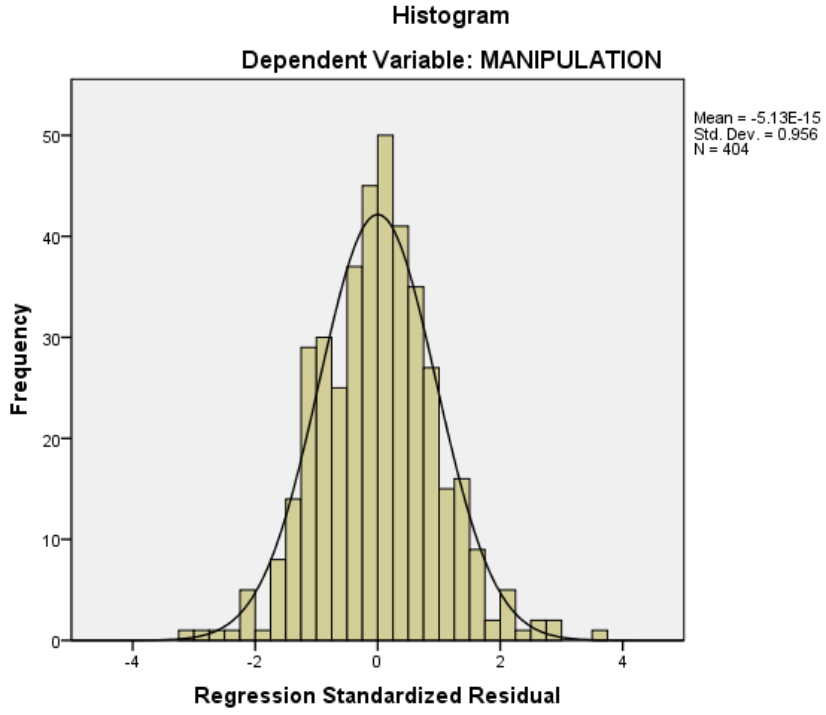


Figure 5 - Manipulation regression equation residuals

(a) Standardised residual plot



(b) Histogram of residuals



(c) Normal P-P plot of residual distribution

