

Farmer's perceptions of coexistence between agriculture and large scale coal seam gas development

Working paper

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The study was conducted in accordance with the guidelines of the National Statement on Ethical Conduct in Human Research (2007) and granted ethical clearance by CSIRO's Social Science Human Research Ethics Committee.

Executive summary

The Coal Seam Gas (CSG) extraction industry is developing rapidly within the Surat Basin in southern Queensland, Australia, with licences already approved for tenements covering more than 24,000 km². Much of this land is used for a broad range of agricultural purposes and the need for coexistence between the farm and gas industries has been the source of much conflict. Whilst much research has been undertaken into the environmental and economic impacts of CSG, little research has looked into the issues of coexistence between farmers and the CSG industry in the shared space that is a farm business, a home and a resource extraction network.

We conducted a series of workshops with farmers from across a broad region undergoing CSG development to explore farmers' perceptions of some of the issues arising from large scale land use change. Workshops explored the importance of place identity and landscape aesthetics for farmers, farmers' acceptance and coping with change, and possible benefits from off-farm income. We found that farmers believed that place identity was not well understood by CSG staff from non-rural backgrounds and that farmers struggled to explain some concerns because of the different way they interpreted their landscape. These differences were the cause of much frustration and farmers felt that this has led to severe impacts on mental health and well being. Farmers felt that a change in culture within the CSG companies will be required if engagement with farmers is to improve and that efforts to employ local people in these communications was helping this.

The workshops also identified a range of issues perceived by farmers arising from increased traffic volumes, impacts to mental health and well being, place identity and loss of water resources for farmers. Finally, it was suggested that scientists and agricultural industry groups will need to work closely with farmers to develop understanding of these emerging issues and to develop solutions that are timely and relevant.

1 Introduction

Agriculture has been the mainstay of economic development in regional southern Queensland throughout the 20th century (Schandl and Darbas, 2008) with fertile soils supporting significant agricultural production. The Darling Downs and Maranoa regions extend over much of this area with a large proportion being used for the grazing of cattle and sheep. The major crops for the region include wheat (*Triticum aestivum*), sorghum (*Sorghum bicolor*), maize (*Zea mays*), cotton (*Gossypium hirsutum*) and various grain legumes.

The Surat geological basin underlies approximately 178,000 km² of this land with significant coal formation occurring within the basin during the Jurassic period (c. 200 – 145 million years ago) (Vink et al., 2008). The development of a broad scale coal seam gas (CSG) extraction industry has accelerated in recent years to take advantage of a predicted doubling of global demand for gas between 2010 and 2035 (Lyster, 2012). CSG is produced from multiple coal seams across the Middle Jurassic Walloon Subgroup (Hamilton et al., 2012) which extends in a NW-SE direction across the Darling Downs and Maranoa regions (Figure 1).

Petroleum leases have already been approved for tenements covering over 24,000 km² of the Surat Basin. The majority of the CSG reservoirs are <600m below the surface (Hamilton et al., 2012) with 28613 PJ of Proved and Probable gas reserves already identified (DNRM, 2014). The number of wells drilled annually has increased from approximately 10 in the early 1990's to almost 1400 in 2013 with gas production increasing from 0.3 PJ in 2004-5 to 150PJ in 2012-13 (DNRM, 2014) (Figures 2a,b). One estimate (Klohn Crippen Berger Ltd, 2012) suggests that annual energy production from the Surat basin could peak at 1700 PJ, from over 20,000 active wells, and with annual water production reaching 175 GL. Another estimate suggests average water production of 95 GL over the life of the industry (QWC, 2012). The CSG industry is currently operating at a small fraction of these expected peak production rates (Figure 2b) as export facilities and gathering networks are still under construction. CSG infrastructure usually consists of a network of well pads inserted into the landscape at a density of approximately 1 to 2 per square kilometre, though it is likely that configurations with multiple wells per pad may be adopted in areas of higher agricultural productivity to minimise impacts as has been the case in the United States (Drohan et al., 2012). Servicing these wells is a network of access roads, pipelines for gas and water, and electrical power supply. In addition there are also more than 4000 km of transmission pipelines to connect producing gas fields to local and export markets.

The benefits from CSG include economic and employment growth, population growth in regional areas, new infrastructure in regional towns, improved medical facilities, increased training and career opportunities as well as a supply of energy with lower GHG emissions than existing coal-fired power stations (Letts, 2012; Measham and Fleming, 2014). However these benefits do come with possible risks to significant ground water resources as much of the land undergoing CSG development lies within the catchments of the Murray Darling Basin or overlays the ground waters of the Great Artesian Basin (Letts, 2012). Concerns about the impact of CSG development on long term agricultural production has led to policies that attempt to protect areas of high agricultural productivity (Owens, 2012) via protecting strategic cropping land via avoiding development and minimising or mitigating impacts (Swayne, 2012).

Whilst the above-mentioned costs or benefits to society and the environment have been described in the literature (Walton et al., 2013; Measham and Fleming, 2014), little has been documented about those perceived by farmers who will now have to live in what has become "a shared space". Much of the land has long been both a family home and a farm business. It is now also becoming host to a large scale resource extraction enterprise. The intermingling of these three entities (Home, Farm, and CSG) has become the cause of much angst within the farming community. The aim of this study was to explore some of the questions raised with respect to place identity, responses to broad scale change, and off-farm income as affected by the rapidly growing CSG industry within the Surat Basin. To do this we have studied the perceptions of farmers on each of the topics, and have explored these with the assistance of geographic, economic and biophysical information for this particular region.

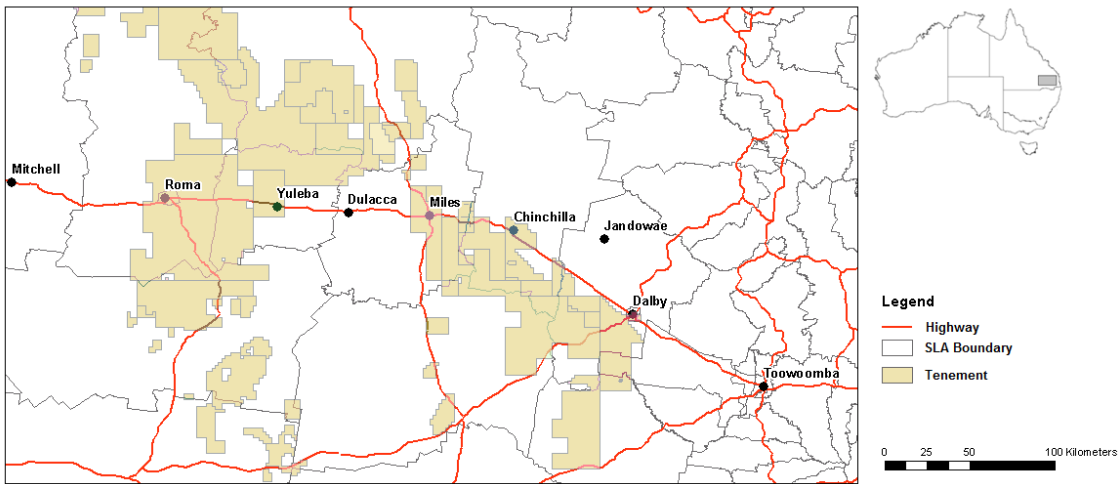


Figure 1. Map of the study region showing the current extent of the coal seam gas tenements for which petroleum leases have been granted and Statistical Local Areas (SLA) used in calculating agricultural statistics.

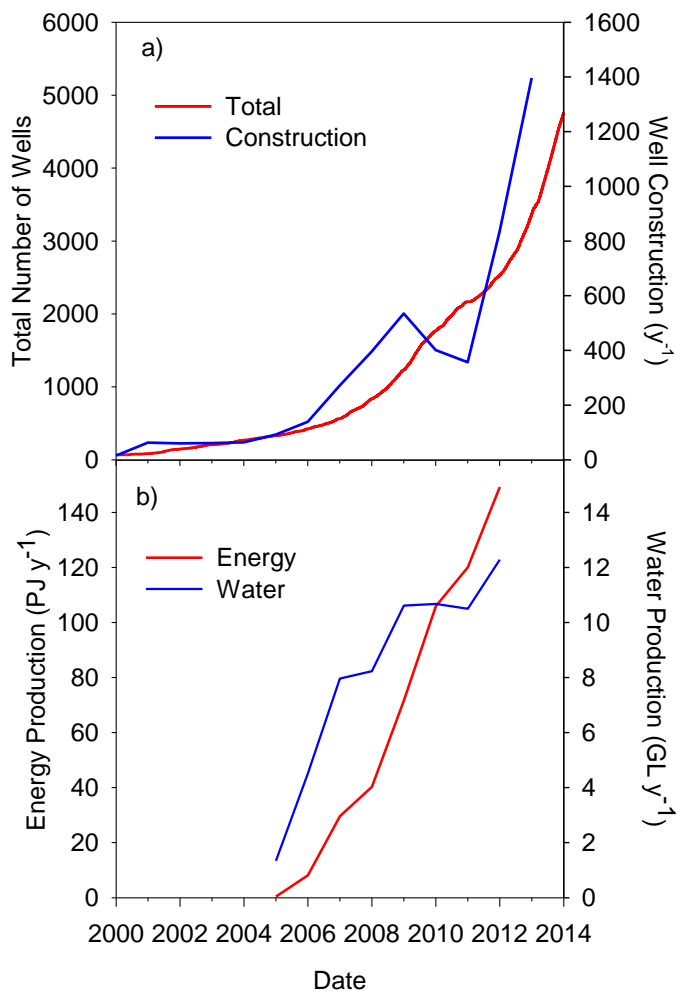


Figure 2. Data describing the development of the CSG industry in the Surat Basin. These include a) the total number of wells and rates of well construction and b) energy and water production from CSG development within the Surat basin for the years 2000 to 2012. (Data sourced from www.mines.industry.qld.gov.au)

1.1 Place identity

Place identity refers to a cluster of ideas about place and human identity in the fields of geography, urban planning and design, landscape architecture, environmental psychology, and urban or ecological sociology. It concerns the meaning and significance of places for their inhabitants and users. Four aspects to place identity have been suggested as being important in perceiving risk for a range of situations where a person's environment is changed (Wester-Herber, 2004):

- Distinctiveness - A place helps to describe someone and sets them apart from others.
- Continuity - Memories of a place can link a person to their past or heritage.
- Self-esteem - A person gets positive feedback from a place with which they identify.
- Self-efficacy - A place facilitates a person's lifestyle.

A change to a particular place, due to any sort of natural process or human development, can have adverse impacts on how people see and express themselves. These impacts are real in that they change how individuals portray themselves, relate to others, ensure their well being, or achieve their own personal goals. There is a belief that place identity is not as easily included in risk management as environmental issues. Whilst complaints about risks to health and safety are readily understood and easy to raise, as has been the case during CSG development, Wester-Herber (2004) suggests that "communication needs to be opened up to include concerns that are not easy to identify, quantify and measure but deal with fundamental psychological processes that might be difficult for the individual to express." It is possible that this difficulty in expressing concern regarding an often misunderstood risk may be a cause to some of the problems experienced by landholders during their early engagement with an industry operative from a non-rural background.

To express these concerns about a place, people may be more likely to describe what they see, and how they feel. But Wester-Herber (2004) suggests that saying "This will look bad and feels wrong" does not carry much weight because such statements may be misinterpreted by another party. In this case, to understand what the person means, one would first need to understand what they see, and how they express this. This provided the next topic of discussion.

1.2 Landscape aesthetics

A common complaint regarding industrial developments, such as CSG, centres on their impacts on landscape aesthetics. However, the real meaning of such statements is not often understood as the personal values that underlie these statements differ between individuals and groups within society (Rogge et al., 2007). For example, in discussing ecological aesthetics, Gobster et al. (2007) suggest that some contexts can elicit aesthetic experiences referred to as scenic beauty, whereas in other contexts they convey perceived care, attachment or identity. In our experience, farmers do state that CSG development on farms "looks wrong" or "is ugly", even though some elements are somewhat similar to existing farm infrastructure. To understand this, we first need to understand the values behind the landscape aesthetic that leads to these statements.

A good example of value-based landscape aesthetic can be found in the unique perspective of farmers who can find ordered and controlled arable landscapes as beautiful when many others may find them featureless or boring. Studies have shown that farmers with knowledge of efficient farming practices 'read' agricultural landscapes in a way that sees straight lines and evenly coloured fields as signs of skilled farming practices (Burton, 2012). Industrial infrastructure is often designed in rigid patterns for the same reasons. No doubt, when different intrinsic perceptions about pattern and efficiency are held by both farmers and industrial engineers there will be disagreement. In this study we seek to understand the role of landscape aesthetics and its underlying values on farmers' perceptions of CSG development.

1.3 Acceptance and coping with change

Change caused by large scale development can have both positive and negative impacts on a region but the pace of this change can cause stress, especially in rural areas. Studies on the impacts of rapid development of coal mining in Queensland (Rolfe et al., 2007) have found large economic benefit, increase in employment and wages, and regional economic growth. However, these authors also found that this growth resulted in labour market shortages, housing shortages and increased rental prices, skills shortages in other sectors, decreased liveability and lifestyle amenity, and impacted on information transfer and long term planning due to rapid changes in the local economy. The response to such changes by those living in an area of rapid development will be affected by their desire to see the benefits, and their ability to cope with the risks.

For adversely affected landholders, a sense of civic duty to support development can arise in response to the potential benefits they may see, be they local or national. For example, Perry (2012) suggests that residents in Bradford County, Pennsylvania, welcomed the early development of the Marcellus shale gas industry as it was seen as something to save the local economy and as a means to reduce foreign dependence on oil. In that county, many members of the community had family or ancestors who had served in the military and energy self-sufficiency was seen as a means to help bring troops home from foreign service. These perceptions fostered early support for the resource development until some of the negative impacts began to be realised. The emergence of both costs and benefits, and subsequently apparent winners and losers, caused fractures within the community resulting in signs of collective trauma (Perry, 2012). Such breakdown of relationships could have significant impacts for farm families where local community, or neighbourly relations, are the main support structures for people living in rural or remote areas. CSG development is known to be bringing rapid change to rural areas in the Surat basin. It is not yet clear how local farming families will be able to accept and manage such a significant change.

1.4 Off-farm income

Farms in Australia are generally characterized as family businesses, with close links between ownership and management. The survival of the smaller family-owned farms in their present form is likely to depend on their ability to keep pace with income growth in the rest of the economy (Males and Davidson, 1990). The availability of off-farm employment in rural areas will be an important component of this. The proportion of farm households seeking off-farm income has increased over several decades to meet farm and family needs. Recent studies (Gleeson et al., 2002; Lim-Applegate et al., 2002) have shown that the reasons for this increase in off-farm income include finance for farm investments and risk management in variable environments, desires to pursue careers other than agriculture, to support ecologically sustainable practices, or to reduce loneliness or isolation. However, participation can be affected by a person's age, education and work experience, presence of preschool children, other income earnings, on-farm labour requirements and the nature of the non-farm labour market such as the proximity of employment centres. These studies have also shown that spouse involvement in non-farm employment was motivated by the desire to cope with shortfalls in the household's ability to procure necessities when other income was low. However, it has been suggested that off-farm employment opportunities are best viewed "not as a means of supplementing low farm incomes but as a way of efficiently using the labour of farm operators and their families" (Quiggin and Vlastuin, 1983) as a means of dealing with the classic "small farm problem" (McKay, 1967). Such a viewpoint is useful when considering farm, regional or CSG development, especially where labour from farm household members is currently underutilised.

Unlike gas development in the United States, where mineral rights may lie with landholders, CSG in Queensland is the property of the State and royalties are payable by companies who have sought a petroleum lease on a given tenement. Legislation requires the CSG operator to compensate each owner or occupier for any "compensatable effect" caused by activities on the land that deprives possession of the surface, diminishes its value or the value of any use or improvement on it, severance of any part of the land from other land owned, any cost, damage or loss arising from activities, or costs associated with negotiating agreements (Swayne, 2012). The value of compensation is determined through negotiations

between CSG companies and landholders. Though termed “compensation”, the funds provided may provide a valuable addition to farm income depending on the success of the negotiations. However, the outcomes of these negotiations are almost always kept confidential, payment schedules can include combinations of up-front and ongoing payments, and payments are required to be regularly reviewed. As a result, the benefit of these payments is not easily understood, especially when compared to the costs of the often intangible impacts being compensated. In this study we seek to define farmers’ perceptions of the value of income from CSG in helping them to achieve their goals.

1.5 Impacts of CSG

Studies in regions undergoing gas (Andersen and Theodori, 2009; Theodori, 2009; Brasier et al., 2011) and coal mining (Ivanova et al., 2007; Rolfe et al., 2007) development have reported a large number of impacts perceived by residents during broad scale and rapid resource development. Furthermore, these perceptions have been reported to change over time as people’s experiences change and develop with the evolving resource industry. For example, Theodori (2009) found that positive impacts were more likely to be perceived in more mature development areas where benefits had time to be realised and observed by residents. Conversely, Perry (2012) found initial acceptance declined once adverse impacts were experienced. The complexity of the impacts as perceived by residents is amplified by the fact that many may be previously unknown to the community, and of varying scale, and this creates a sense of uncertainty and unpredictability (Walton et al., 2013). Whilst it may be difficult to capture all these issues in the early phases of CSG development within the Surat Basin, this study will seek to capture farmers’ perceptions of the likely impacts at a single point in time during rapid development.

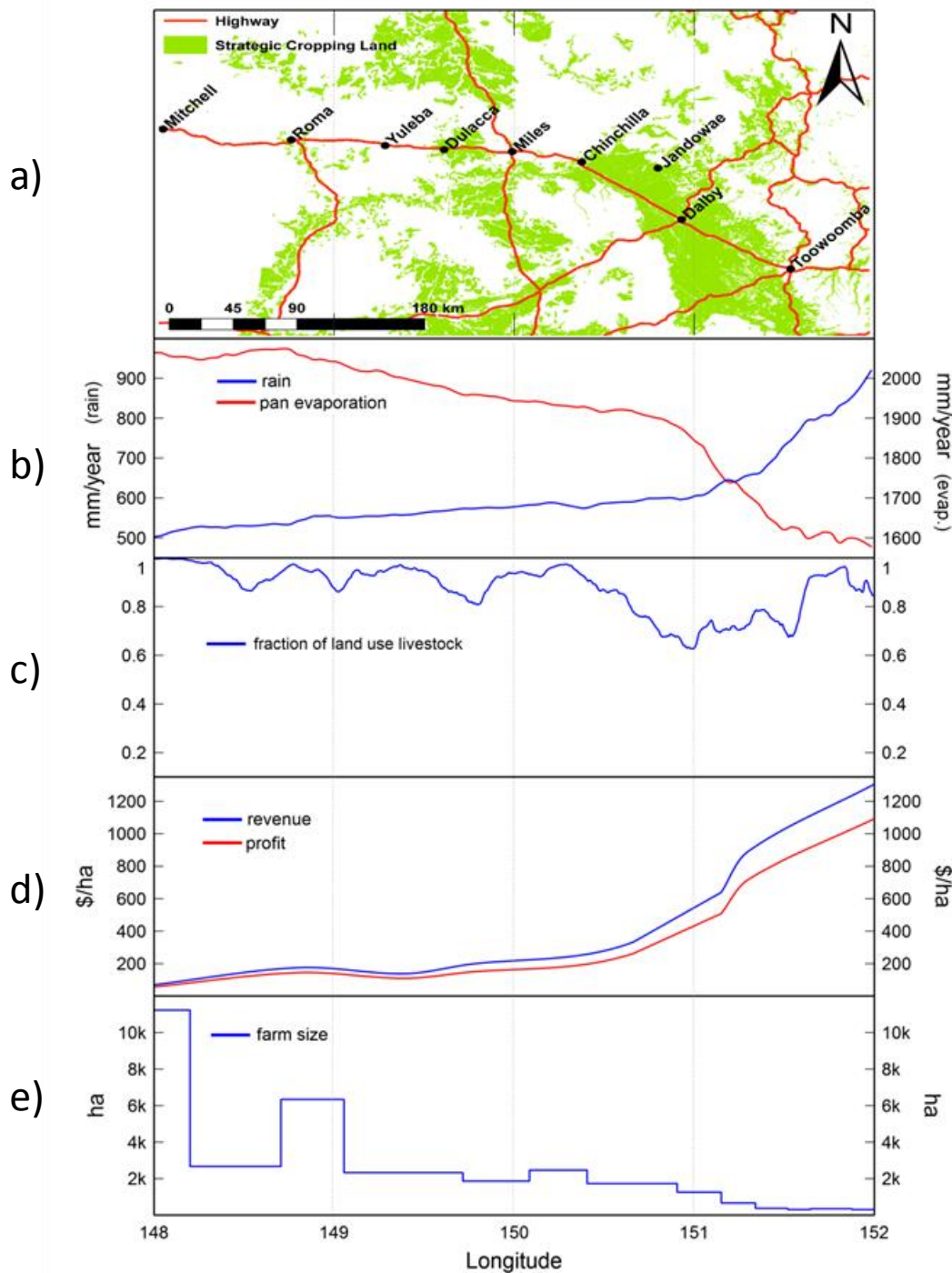


Figure 3. A description of some major environmental and economic E-W gradients across the study area. Data shown include a) the location of Strategic Cropping Land (DERM, 2010) (as determined by high soil quality. See text for more detail), b) mean annual rainfall and evaporation (mm), c) mean annual revenue and profit at full equity (PFE) (\$/ha), d) fraction of land used for livestock, and e) mean farm size (ha). Economic values have been averaged within a 40 km zone around the regional population centres shown in (a). Values for average farm size have been computed per Statistical Local Area (SLAs shown in Figure 1.1).

2 Methods

2.1 Farmer workshops

Small discussion groups were held in the townships of Roma, Chinchilla and Dalby to study the views of farmers regarding co-existence of farming with the rapidly developing CSG industry. These areas were chosen because they cover the range of agricultural diversity within the Surat Basin (Figure 3). Previous studies comparing differences in landholder perceptions have shown that population size, proximity to major centres or transportation networks, and the level of extractive industry development all influence people's perceptions of the local impacts (Brasier et al., 2011). The western area around Roma is mostly used for grazing because of the types of soil and the warmer, drier climate and, as a result, farm sizes are large. Resource extraction industries have a longer history around Roma and much of the earlier CSG development was in this area. The Chinchilla region includes a greater mix of cropping and grazing and was undergoing an initial rapid increase in CSG development during this study period. The eastern Darling Downs around Dalby has a much greater involvement in cropping due to more suitable soils, higher rainfall and access to irrigation water supplies. As a result farm sizes are much smaller and agriculture is much more intensively managed with higher value commodities. Whilst some CSG development has commenced in some of the eastern zone, the more intensively farmed irrigation areas are yet to be developed for CSG because of the complexities involved.

For each location, a list of potential participants was collated with input from stakeholders such as coal seam gas companies, agribusiness, environmental groups, farmer groups and local government. From this list, a subset of participants was chosen to represent differences in age, gender, farm enterprise (e.g. cropping, grazing, and irrigation) and geography. Each participant provided informed consent for involvement in the exercise. Issues of farm and CSG co-existence have become grounds for much debate, and indeed conflict, as CSG development has accelerated. Therefore, each workshop was managed to minimise the potential for conflict, or stress to individuals. The number of participants in each workshop was kept to a manageable size to allow all participants an opportunity to express themselves and to allow the facilitator to retain control of discussions should strong differences of opinion arise. No CSG company staff were present during the discussions to allow participants to openly express their views regarding CSG company interactions. As a result, it is important to note that discussions of co-existence are from the farmers' perspectives only.

Discussions were held over the course of approximately three hours and no payments were made to individuals for their participation. Each discussion was led by the same researcher following a common agenda across the three sites. An audience response system (Turningpoint Technologies®, USA) consisting of wireless handheld devices was used to quickly collate individual responses to a range of questions whilst retaining anonymity of the respondent. A series of example questions on fun topics were evaluated with the participants before commencing the main discussion to ensure all were competent in using the technology and that they understood the process that was to be followed. Questions were structured to allow categorical answers (e.g. Strongly agree, agree, neutral, disagree, strongly disagree) and a graphical summary of the results was only provided for all to see after polling was complete so as to minimise influence between participants. Open discussion was then held to allow detailed discussion of the issue and the possible causes of the distribution in user responses. When confirmation of previous research was required of the participants, a range of exploratory questions from within that problem domain was asked before the research findings were discussed. This minimised any bias caused by leading of the participants, and also provided their responses as a driver for the ensuing discussion. Question, answer and discussion sessions were held around the topics of Place Identity and Landscape Aesthetics, Acceptance and Management of Change, and Off-farm income.

After these a “Brain Storming” session was held with each group toward the end of the three hour period to document the range of impacts of CSG development on farms and farmers. Techniques such as these are often used to explore very large or complex problem spaces through harnessing the collective thoughts or experiences of a group of people. In this particular type of approach, participants are asked to respond to a given question or problem with a brief idea, word or phrase and ideas are collated quickly without in-depth discussion or consideration of merit. Only after input is exhausted are the ideas discussed in detail, evaluated and analysed for synergies. In these workshops, participants were asked to nominate ideas, issues, keywords or phrases in response to five subject areas: Health, Environment, Farm Business, Family Home, and Personal Issues.

Finally, a brief discussion was held with each group to determine their views on how information from scientific enquiries such as these should be communicated, and to whom, with the aim providing improved co-existence strategies.

2.2 Agronomic and environmental data

A range of economic data was collated to assist in understanding the issues raised by farmers during the workshops. Agricultural economic data, namely revenues and profits, were mapped using a database system developed by Marinoni et al. (2012). This system produces a map of agricultural profit at full equity (PFE) based upon land use information, remote sensing data, commodity-based costs and prices, and census data. PFE is calculated as gross revenue (\$ ha⁻¹ year⁻¹) less the production cost (\$ ha⁻¹ year⁻¹). The raster based profit maps were created using a set of national land use maps with a resolution of 0.01 degrees, or approximately 1.1 km for the region of interest. The system allows for a variety of attributes to be associated to each pixel (or raster cell). Using these data, PFE and revenue estimates were produced for the years 1992-93, 1993-94, 1996-97, 1998-99, 2000-01, 2001-02 and 2005-06 due to the availability of both a land use map and census information. The latest land use map reflecting the census year 2010-11 was not yet available at the time of these analyses and so a map of PFE for 2010-11 could not be produced.

3 Results

3.1 Agro-economic and environmental data

Figure 4 shows maps generated to demonstrate agro-economic variation across the study region. Artificial spatial patterns within the maps are caused by the underlying spatial entities (Statistical Local Areas, see Figure 1) used when conducting each census. Notwithstanding these, Figure 4 shows that profits and revenues per unit area decrease in a westward direction under the influence of changing climate and soil (see also Figure 3d). Much of the early CSG development was undertaken within the western part of the study region. Approvals are currently being sought for petroleum leases for tenements covering the areas of high agricultural production within the intensively farmed areas south of the town of Dalby.

It can be seen that much of the area providing high levels of agricultural productivity lie within the areas prescribed as Strategic Cropping land (SCL) as shown in Figures 2 and 3. Queensland government policy for SCL states, “The best cropping land, defined as strategic cropping land, is a finite resource that must be conserved and managed for the longer term. As a general aim, planning and approval powers should be used to protect such land from those developments that lead to its permanent alienation or diminished productivity” (DERM, 2010). The confluence of more suitable climate, good quality soils, higher production, smaller farm sizes and closer proximity to the major centre of Toowoomba has made considerations for coexistence of CSG and agriculture much more difficult for the areas within the eastern Darling Downs.

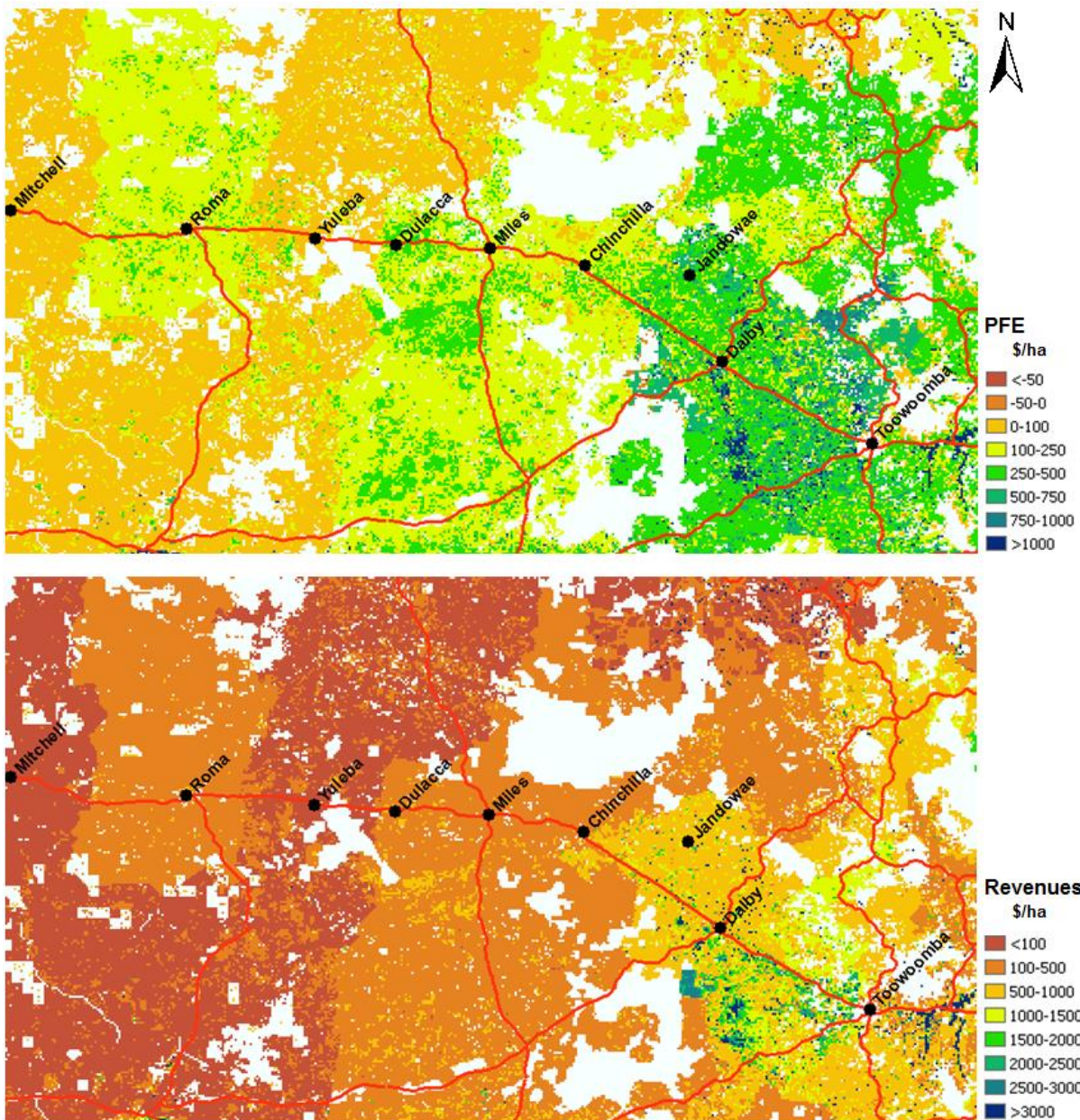


Figure 4: Maps showing estimates of agricultural economic performance across the study area. These include a) average profit at full equity (\$/ha) and b) average revenues (\$/ha) for the years 1992 to 2006 with values in 2006 dollars. Unshaded areas show those not used for agricultural production.

3.2 Farmer workshops

Twenty-two people from farming families took part in the discussions across the three workshops. Many farmers approached to participate declined for reasons sometimes referred to as “workshop fatigue”. Others were preoccupied with legal proceedings. As will be discussed below, many farmers had already found themselves heavily involved in negotiations with CSG companies or information sessions to help them in these proceedings. As a result, many could not provide the time required to be involved. However, the cross-section of the community provided by the three workshops captured much of the diversity of agriculture across the Surat Basin. Results below have been summarised across the three workshops.

Participants were involved in the conduct of a wide range of farm enterprises including cropping, grazing and mixed farming systems (Figure 5a). Approximately 80 percent of participants had grazing as part of their business whilst about one half of the participants undertook some level of cropping. Whilst some

participants currently had no CSG infrastructure on their farms, all participants were currently involved in negotiations or operations with CSG companies, with approximately one third of participants interacting with more than one CSG company (Figure 5b). Many participants mentioned that they also had to deal with a significant number of large non-CSG companies on a regular basis. These included companies seeking to construct pipelines or electrical power transmission lines through their properties, and a wide range of contractors for the CSG companies.

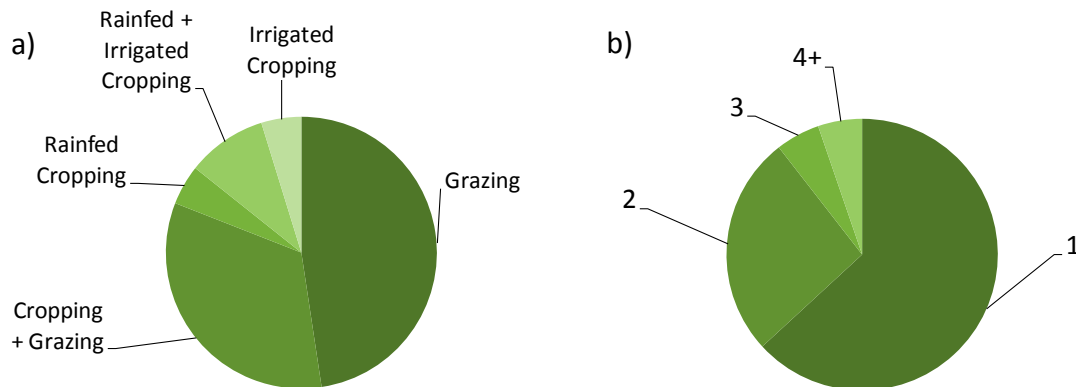


Figure 5. Background information for participants in the three farmer workshops including distribution in a) enterprise type and b) the number of CSG companies interacting with each person.

3.3 Place identity and landscape aesthetics

Group discussions commenced with an exploration of issues of place identity. Five questions were asked of the participants before opening up the discussion. The four aspects to place identity suggested by Wester-Herber (2004) were clearly identified as being important to farmers in their responses to a series of simple questions (Figures 6a-d). The importance of landscape aesthetics also emerged from the responses (Figure 6e). In fact, after having the ideas of landscape aesthetics explained to them, participants readily grasped the idea of values behind aesthetics and often started to explain the aspects of place identity described by Wester-Herber (2004) in terms of order, tidiness, and aesthetics. Many could sum it up in simple statements. For example, one grazier explained that “Tidy is healthy”. Although recent changes in attitude now value elements such as fallen trees as habitat for native animals, it was felt that a “messy farm” may be an indicator of a wider problem. Neatness is identified as part of farm hygiene and is therefore important. In another workshop, a cropping farmer stated that “Tidy is efficient”. Here, neatness, order or aesthetics has a lot to do with time management and efficiency of farming operation on intensively managed farms. The majority of farmers felt that the tidiness of the farm was important in showing their care and concern for the land. They also thought that it was an indicator of a much deeper attachment to their ‘piece of paradise’, their home, their place, their country. Issues affecting these landscape aesthetics, and the impact on the observer, occurred at multiple spatial scales with the farmer integrating them into their perceptions. As one farmer suggested “Farmers live with the whole screen. They are seeing the whole picture, not just components of it”.

The discussions with the farmers covered a myriad of topics, demonstrating the importance of the four aspects of place identity (Distinctiveness, Continuity, Self-esteem, and Self-efficacy). We can only briefly describe some of them here. The aspect of distinctiveness was clearly shown in the pride they took in the way their farm looked and operated. They saw the farm as an extension of themselves. Any development that impacted on the way a farm looks and operates impacts on how they see and portray themselves. Many farmers and their families had a long term connection to their farm. This demonstrates continuity of their home with the home of their family, including their ancestors. High levels of CSG-related traffic on

their farm were said to introduce concerns of safety and security for their families and this threatened to impact a family lifestyle that they had enjoyed on that same farm when they themselves were young. For some farmers, the impact of CSG infrastructure on the landscape's aesthetic value was such that they were thinking of moving even though they had planned to retire onto their property. They were caught between maintaining continuity and coming to terms with landscape change. Farmers' self esteem was clearly shown in their explanation of how they took pride in the aesthetics of their farms and how this portrayed notions of technical prowess and care for the land. It was clear that for some farmers, CSG infrastructure had impinged on the positive feedback that they had been receiving from their farms. Finally, there was much discussion on the impact of CSG development on farmers' self-efficacy. Farmers were deeply concerned about the risk of loss of ground water, impacts on their farm operations and the values of their properties. Their farms are their livelihoods and any adverse impact on the farm is not just a loss of money. It is a restriction on their ability to meet their personal goals.

The addition of CSG infrastructure into the farm landscape has raised concerns with many landholders due to perceived risks to the environment, family and business. Many of the landholders involved in the group discussions described problems in communicating their concerns with CSG companies. Our interpretation of this issue, based upon the discussion group findings, suggests that this has been due to both the difficulty of raising place identity as an issue worth concern, and people's ability to communicate it, especially when farmers can look at the landscape, and its changes, and interpret it in ways that some CSG company employees may not.

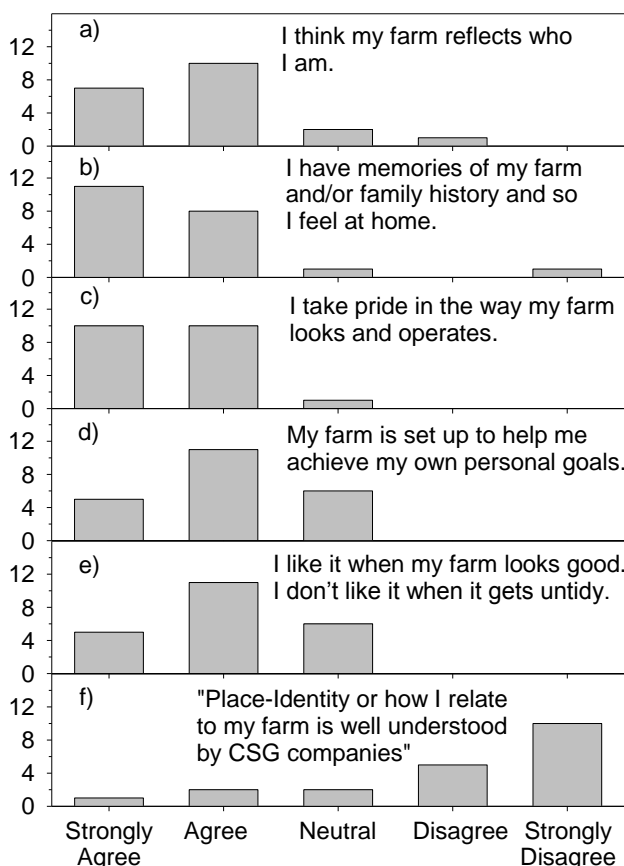


Figure 6. Distributions of participant responses to six questions exploring the issues of place identity and landscape aesthetics.

3.4 Change acceptance and management

Discussions then moved onto the issues of change, including acceptance of change and farming families' capacity to cope with rapid changes. This was done by explaining and comparing trends seen by Perry

(2012) during development of Bradford County within the Marcellus shale gas field. The notion of civic duty and its role in early acceptance of CSG development was the first issue explored. In Bradford County, early development is said to have been supported in part because of perceived benefits for the national interest. Our participants were asked to respond to the statement “I feel a civic duty to support CSG as part of the national or local economic interests”. The responses were varied (25% Strongly Agree or Agree; 45% Neutral; 30% Disagree or Strongly Disagree). Those who disagreed felt that the majority of profits would leave the country via international CSG companies, that agriculture provided much better benefits in the longer term with much lower levels of government support, and that their support for such a development was moot in any case because it had already been supported via government legislation. Those who answered indicating some level of civic duty did so out of concerns for local, not national, duty. They felt some need to be involved in a development that may provide for local jobs, especially for younger people. However, as seen by Perry (2012), support or feelings of civic duty seem to be waning once the impacts of large-scale development are realised. Some statements describing support for local development were soon followed by discussions of the perceived adverse impacts of these same local economic benefits including the changing nature of rural towns, crime, rising labour costs, and difficulties in engaging local tradesmen or experienced labourers. The benefit of employment for young people was quickly balanced by the competition with local family businesses by new externally-operated companies.

Further discussion then explored the ability of farming families to cope with such rapid change. Participants were questioned regarding a particular trend observed by Perry (2012) in Pennsylvania where changes in the nature of relationships between local people emerged during gas development. When surveyed, 90 percent of participants agreed or strongly agreed that their neighbours and community were important to them as a farmer and as a resident. The patterns of relationship breakdown caused by inequalities in costs and benefits observed by Perry (2012) were described to the participants and they were asked if they were aware of any similar changes occurring locally. The participants suggested no strong evidence as yet of breakdown in relationships between farmers. They felt that there was a general acceptance each farmer would have different plans for their property and their farm business and that farmers should be entitled to plan as they see fit. However, it was clear to them that there is a great potential for friction to occur between neighbours, and that the increased conflict seen overseas could eventuate in their area. Possible causes of conflict include inequity in access to water produced by the CSG extraction process, differences in acceptance of the CSG industry, or impacts of CSG development that may reach across property boundaries (e.g. pollution). However, it was generally acknowledged by the farmers that it may still be too early for some of the relationship impacts of rapid CSG development to be observed given that the CSG industry is still in the early phases of its development.

Finally, one clear similarity with the observations in Bradford County was observed even though it was not explicitly sought. Perry (2012) explained how people experiencing gas development described the experience using terms such as “invasion” or “occupation”. The same language and metaphors were used in the various discussion groups in this study. There was a real sense of the farm being their “country” and therefore the unrequested intrusion of CSG development was seen as an occupying force. The use of common high visibility uniforms by all CSG and contractor staff further supported the analogy, though interestingly one participant adapted the wording to an agricultural metaphor in describing the large workforce as an invasion by an “orange fungus”. A previous study in Chinchilla found residents describing a ‘tsunami of change’ (Walton et al., 2013). In either way, the use of such wording clearly indicates the perceptions of local farmers regarding the nature of the CSG development to date.

3.5 Off-farm income

Extra income from CSG compensation payments is seen as one benefit for farming families arising from CSG development. Eighty percent of respondents said that they had now, or in the past, utilised off-farm income. This is in accordance with previous studies in rural Australia (Gleeson et al., 2002; Lim-Applegate et al., 2002) which have shown the importance of off-farm income for many farming families. Before asking participants to discuss the issues of income from CSG compensation payments, we asked them to first think about their personal goals, including those driven by business, family, beliefs/morals (e.g.

environmentalism) or aspirations. They were then asked whether their farm was set up to help them to achieve their goals. Nearly three quarters of respondents agreed or strongly agreed with this statement with the remainder neutral or uncertain. Nobody disagreed with the statement. This suggests that most farmers involved in the workshop felt they were already empowered and able to set and achieve personal goals. This may reflect a bias in our sample of the farming community commonly seen where empowered farmers are more likely to engage with researchers. When the participants were asked whether, if done well, CSG compensation payments would help them achieve their goals, the responses included 1 strongly agree, 1 strongly disagree, with the rest fairly evenly divided between agree and neutral. This result was explained as arising from two causes. Firstly, as shown earlier, most farmers in the discussion already felt able to meet their goals. Secondly, whilst open to the idea, there was great uncertainty about the nature and likelihood of developing a joint CSG-farm enterprise that met their expectations. The reader is reminded that unlike some other resource development areas, landholders in this area do not own mineral rights and work on a compensatory payment scheme. Uncertainty remains with respect to impacts on property values, long term negotiations, changes in company ownership, duration of CSG extraction and impacts on the farm business operations. The current compensation model was not seen as attractive as a partnership model. Participants currently saw CSG companies aiming to make large profits and felt that a system that allowed them to gain a reasonable share in this for their support was only fair. It was also felt that for the business model to work, it would need to allow investment into the farm asset base which would then assist any future sale price. Any development that undermined the value of the overall asset, such as through environmental harm, was a concern. Finally, there were also some reservations regarding the partnership model because unlike many other business partnerships, this was not a voluntary partnership. Furthermore, the taxation implications of such a change from compensation to partnership were a concern for some.

3.6 Company engagement

The nature of CSG company engagement with farmers was a clear theme behind much of the discussions described above. It was very clear from the participants' responses that farmers believed that large multinational companies did not understand the issues of individuals, and were not concerned with the interests of individuals. They felt that, during rapid CSG development, individual farmers were seen as easy targets when companies needed quick results. The reader is reminded of the sudden increase in growth described earlier (Figure 2) which is due to rapid development required to service export facilities due for commissioning. This is likely a reason for the farmers' responses. The work of the CSG companies in developing their social licence to operate was acknowledged by the participants, especially in western areas where the CSG industry is more mature and where remote communities could more easily benefit from extra support. But across all workshops, people were cynical about the "hearts and minds" programs which also included much advertising and sponsorship. In fact, many references were made to a particular circumstance where a CSG company's sponsorship of a local agricultural show was withdrawn due to animal rights concerns. This was interpreted by the farming community as a demonstration of a lack of understanding of farming communities on the behalf of the CSG industry, who they felt, in this case, was more interested in purchasing good will than investing in the community. Most farmers felt that they did not have the time or resources to respond within the public debate to argue their position and so could not engage in a similar way through media, sponsorship or advertising. However, members of strong farmer groups within the highly productive areas of the eastern Darling Downs suggested some capacity to engage this way. An example was given of a farming community that had undertaken sponsorship of a service that would have otherwise been provided by a CSG company.

It was acknowledged quite often by participants that, though the companies as a whole did not understand their values, there are individuals within the companies that come from farming backgrounds and so can relate to the concerns of farmers. Most attendees felt that the CSG Farm Liaison Officers did a good job and had an affinity with farming, often because they were employed from the local areas, were often raised on farms, or were even known by the farmers. Whilst this was sometimes seen as "head-hunting of locals" to provide local advantage, many had found that the company staff from rural backgrounds were now more approachable, could better understand the issues, and were therefore more willing to

understand and negotiate. This sort of experience was given as the cause for the wide range of responses in questions regarding CSG understanding of farmers' issues (e.g. Figure 6f). The frequent staff turnover during resource booms such as this has meant that these more productive relationships are often truncated and participants were clearly frustrated by having to constantly rebuild relations with the companies.

The general perception seemed to be that problems of communication came about when dealing with higher level management, including those based in urban centres. The method of business engagement employed by the companies was seen as difficult for farmers. They felt that they were having a competitive "big industry" approach forced upon them via the way the companies wanted to do business. Many farmers are more accustomed to a business approach that is not just a financial negotiation, but a relationship which then develops to benefit both parties. Though some acknowledged that part of the problem may be their difficulty in adapting, many of the stories offered as examples detailed instances where farmers were having trouble interacting with a potential business partner who would seek to resolve negotiations through approaches that sought to put a market value on home, history and lifestyle with a large amount of pressure being exerted for farmers to make quick decisions on difficult problems. To deal with this disconnect, participants explained that they are now utilising the services provided by agricultural industry groups to learn negotiation skills and their rights in negotiating with CSG companies. Farmers are now charging companies for time taken in the negotiation of contracts including meetings, time taken on phone calls and visits to lawyers. Farmers in the eastern parts of the study area have also started negotiating as farmer collectives rather than individuals. Whilst these changes in the approaches by farmers, and the response by CSG companies in encouraging them, are seen by farmers as a positive development, the discussion groups suggested that there is still much improvement to be made in the way that the negotiation processes take place.

Finally, contractors working on-farm were also seen as an important issue. The farmers felt that many contractors come from outside the local area, have no affinity with the land, or understanding of how a farm operates and its requirements. This is important given that contractors are often the agents of interaction with farmers rather than the CSG companies themselves. Workshop participants relayed many stories of bad experiences with contractors who had allowed stock to escape, lost keys to gates, frightened livestock such that animals had injured themselves, left rubbish on a farm, or had acted inappropriately. Whilst contractors may only interact with a farmer once, and therefore could possibly not value the relationship with the farmer, they are seen as operating for the CSG company and so can heavily impact farmers' perceptions of the company. The large number of contractors and the similarly large and regularly changing number of CSG company staff was a source of frustration for farmers who were trying to maintain a suitable level of management and control over their farm.

3.7 Impacts of CSG development

A combined total of 139 ideas were presented during brainstorming across the five subject areas (Health, Environment, Farm Business, Family Home, and Personal Issues) used as stimuli for responses. A great deal of overlap was found between responses obtained between discussion groups and subject areas. Therefore, the ideas were collated, and reduced to common terms where possible. For example, the terms "anger" and "arguments" were combined with "conflict". The filtered responses for the five subject areas are shown Table 1. The cause of each of the issues was then attributed to the three main causes of impacts on farmers: traffic (e.g. trucks, rigs, cars), gas infrastructure (e.g. wells, roads, pipelines), or engagement with the CSG companies (e.g. compensation negotiation, contractors, ongoing access to farm). Further to this, it was noted that several common themes emerged from the responses. Four have been highlighted in Table 1: Water, Atmospheric Pollution (including dust, light, noise), Place Identity, and Personal Wellbeing.

Several trends can be seen in the responses. Firstly, whilst much discussion in the media has revolved around the impact of CSG infrastructure on the environment, traffic was clearly shown as the cause of many issues and that these issues impact on nearly all aspects of the farmers' lives. In a study of the Barnett Shale region of Texas (Theodori, 2009), "Increased truck traffic" scored highest amongst

respondents as an issue that was getting worse and six of the top twelve negative issues could be directly related to traffic. These concerns were echoed in surveys of local leaders in the same region in Texas (Andersen and Theodori, 2009) which showed large concerns for the volumes of traffic, largely due to water transportation for the well-fracturing process, which they felt posed a threat to other drivers. Those surveyed in that study felt that truck drivers failed to adhere to legal and customary precautions and that this resulted in increased accidents, including fatalities. This traffic was also described as impacting on the local way of life and led to roads being damaged faster than they could be repaired. Light and noise pollution from round-the-clock drilling processes was also raised as a major concern in surveys in the Burnett Shale development of Texas (Andersen and Theodori, 2009) with road damage also a major issue for rural people (Brasier et al., 2011). It is clear that increased traffic during the rapid growth in CSG development is having similar impacts in the Surat Basin. Current efforts by farmers and companies to address these include the use of guidelines for acceptable traffic movements with vehicle monitoring systems to police on-farm traffic and vehicle wash down procedures to minimise the risk of weed seed spread.

Secondly, engagement with CSG companies impacts on wellbeing in ways that affect personal lives, families, and ultimately on health. Farmers are concerned about possible impacts of infrastructure on the environment and how this subsequently impacts the health and effectiveness of themselves and their farm. However, much of the impact on wellbeing discussed in these workshops arose from the ways that farmers and CSG companies had been interacting. This has resulted in issues of stress, conflict and disconnection. Whilst this has been discussed in previous sections, the brainstorming sessions clearly demonstrated how these issues impacted on various parts of farmers' lives.

Perhaps the most obvious trait of the ideas provided by the brain storming was that they were all negative. The same trend was obtained at all three workshops and therefore there is a possibility that this outcome was somehow influenced by the process used. However, given that discussions prior to the brainstorming session had explored both positive and negative impacts, risks and opportunities, it was significant that only negative responses were evoked when people were asked to respond relatively quickly and without disruption to the various subject areas used as stimuli. Given the level of uncertainty and stress experienced within the farming community, including the participants in this workshop, it is not unexpected that people would take a cautious approach which questions everything and concentrates mostly on risks. Theodori (2009) found that perceptions of positive changes due to shale gas development were stronger for areas where the industry was more mature. In other words, it took time for benefits to be realised and then perceived by local people. It may be that positive outlooks toward CSG development by farmers in the Surat Basin may take some time to develop further.

Table 1. Impacts of CSG on farms and farmers as captured in the condensed results from the brain storming exercise (grey shading) and attribution of cause between traffic, infrastructure or method of company engagement. Several themes within the responses are specifically highlighted, including water impacts (Water), atmospheric pollution (Pollution), place identity (Identity), mental health and wellbeing (Well Being) or other (Other).

| Brain Storming Data | | Traffic | Infrastructure | Engagement |
|---------------------|-----------------------|-------------------|------------------|-------------------|
| Environment | Visual Impact | | Identity | |
| | Water Quality | | Water | |
| | Water Loss | | Water | |
| | Salt Disposal | | Water | |
| | Noise | Pollution | Pollution | |
| | Dust | Pollution | | |
| | Light | Pollution | | |
| | Risks to flora/fauna | Other | Other | |
| | Soil Degradation | Other | Other | |
| | Weeds/Biosecurity | Other | Other | |
| Personal | Loss of connection | Identity | Identity | Identity |
| | Leaving the farm | | | Identity |
| | Relationships | | | Identity |
| | Impact on Social Life | | | Well Being |
| | Mental Health/Stress | Well Being | | Well Being |
| | Hopelessness | | | Well Being |
| | Conflict | | | Well Being |
| | Complexity | | | Well Being |
| | Workload/Time | | | Other |
| | Finance | | | Other |
| | Security | Other | | |
| Home | Security | Identity | | |
| | Safety | Identity | | |
| | Amenity | Identity | Identity | |
| | Privacy | Identity | | |
| | Conflict | | | Well Being |
| | Mental Health/Stress | | | Well Being |
| | Dust | Pollution | | |
| | Light | Pollution | | |
| | Noise | Pollution | Pollution | |
| | Workload/Time | | | Other |

Table 1. continued...

| Brain Storming Data | | Traffic | Infrastructure | Engagement |
|---------------------|-----------------------------|----------------------|------------------|-----------------|
| Farm | Loss of control/Uncertainty | Identity | | Identity |
| Business | Lifestyle | Identity | Identity | |
| | Water Supply | | Water | |
| | Animal Welfare | Pollution | | |
| | Labour | Other | | |
| | Weeds/Biosecurity | Other | | |
| | Farm Logistics | Other | | |
| | Property value | | Other | Other |
| | Road Congestion | Other | | |
| | Compensation | | | Other |
| | Workplace Safety/Security | Other | Other | |
| | Taxation | | | Other |
| | Workload/Time | Other | | Other |
| | Health | Mental Health/Stress | | |
| | Water quality | | Water | |
| | Dust | Pollution | | |
| | Noise | Pollution | Pollution | |
| | Light | | Pollution | |
| | Fugitive Emissions | | Pollution | |
| | Pressure on health systems | | | Other |
| | Traffic safety | Other | | |
| | Workload/Time | | | Other |
| | Power Lines/Radiation | | Other | |

3.8 Research communication

The final part of each workshop discussion addressed the issue of communication, in particular, what was required to communicate issues, including those discussed during the workshop, to an appropriate audience. The groups identified a need for providing “facts and figures” on a range of issues. These included the economic return to farmers of different models of co-existence and compensation payments, impacts of CSG infrastructure on farm operations and productivity, and impacts of CSG developments on the environment so that farmers could understand the likely impacts on their own farms. Information needed to be targeted, up-to-date and relevant for landholders already “drowning in information” provided to them by the various parties they were already dealing with. It was felt that glossy brochures, or press statements from CSG companies would not have much impact, but that face-to-face reporting of research outcomes needed to occur with collaborators and stakeholders. Given the frequent turnover of staff within CSG companies, and the perceived disconnect between CSG company staff and farmers, workshop participants strongly suggested that it was most important that the information was “put directly into the hands of the farmers” so that they could use it in their planning and negotiations.

Notwithstanding the statements outlined above, several other suggestions were given. It was suggested that key information needed to be provided to regulators given the experiences of several farmers that led them to believe that companies organised their operations simply according to the relevant legislation. Others suggested that there still needed to be much more communication of issues to people in urban centres who were removed from the situation, though they thought that focus would need to concentrate on environmental impacts because, as with the companies, rural issues or issues of place identity may not be understood.

4 Discussion

For many people, and not just farmers, the coincidence of farm, household and resource industry creates a tension because it is an unusual mixture of elements. For some, the unsettling nature of the change forces them to grapple with new issues. Pasqualetti (2000) describes some consequences of the very different nature of wind-energy landscapes where the very visible presence of large turbines in rural landscapes, or sometimes in close proximity to people's homes, reminds us that our energy comes from somewhere and that there are inherent costs associated with our energy consumption. This is also true for CSG developments which require wells, pipelines, larger roadways, access tracks, warning signs, processing plants and the like. Unlike some other energy sources, wind and CSG developments are conspicuous because they have visible elements that lie within a space where people live. In the rural areas of the Surat Basin, CSG developments are being undertaken on farms that are both the family business and the family home. The intrusion of a conspicuous large development on quiet country lifestyles has been the source of much conflict as found in this study.

Whilst CSG development may be a very visible reminder of the costs of energy consumption, much of the development thus far has been undertaken in remote rural areas which are not within view of most people. Furthermore, the ways in which the people that live in these landscapes see these impacts is also not well known by those removed from the situation. We sought to address this information gap in this paper. However, even if understood, the legitimacy of some of these issues as part of a negotiation for co-existence is not always accepted. As Wester-Herber (2004) states "The process of risk communication needs to be opened up to include concerns that are not easy to identify, quantify and measure but deal with fundamental psychological processes that might be difficult for the individual to express." This study has shown that there would be benefits for farm-CSG coexistence from such an approach. Therefore there are great benefits to be gained from simply asking "What is your connection to this place? What is important to you about this place?" (Perry, 2012).

We discussed landscape aesthetics and how these can be used to explain landscapes that are in harmony with values of the observer. A better understanding of "what farmers see" when they seek to explain landscapes and how they would see certain changes would greatly benefit CSG companies. Some researchers would go further and suggest using landscape aesthetics as a tool for designing landscapes. Gobster et al. (2007) describe a process that seeks to align landscape goals with aesthetic experience through using aesthetic value as an indicator of sustainability in the context of the values of the beholder. In this case, if a landscape developed for CSG still has aesthetic value to the land holder this may indicate harmony with the ecological, agricultural and personal values of the of the land holder. Or conversely, developments that act to the detriment of the landscape aesthetic may be an indicator of an intervention that conflicts with the values of the landholder. However, as Gobster et al. (2007) also state, such an approach could also be used to promote landscape change that fosters positive aesthetic experience to the detriment of sustainability. For example, Good (2006) explains how two people can appeal to the aesthetic value of a wind farm based on entirely different values. If we translate their example from wind farms into CSG, we can easily contrast one person who sees the beauty of a family farm affected by the ugliness of a CSG well that impacts on farm efficiency, versus another person who sees the beauty in a neat, well designed gas well that produces a cleaner energy that can reduce the ugliness of a farm reliant on more greenhouse gas intensive energy sources. In the case of the coexistence between CSG and farming, the two sides need to be able to understand and recognise the different meanings in seemingly similar points of view. It is possible that as time evolves, and perspectives on CSG development change (Theodori, 2009), a new landscape aesthetic may arise that values both enterprises (Selman, 2010).

It was obvious from the various discussions that participants were looking for continuing improvement in the way that companies engaged with individual famers and the community as a whole. As stated earlier, participants could already see steps by companies in this direction. The desires of the farmers are in line with other calls for new attitudes toward the social licence to operate that see "authentic participation

based on mutual respect, consultation, dialogue and consensus building, which translates into communal action for sustainable development” (Manteaw, 2008). Corporate Social Responsibility is likely to become more effective when it becomes a collaborative process where people are effective in managing their livelihoods, and corporations gain deeper insights that inform their business policies and the ways they engage with the community. Such an approach to dealing with individuals may help to avoid much of the stress and impacts on farmer wellbeing.

Finally, there are messages here for the research community as it seeks to provide information relevant to the issues of co-existence for CSG and farming. For information to be useful, relevant and timely, science will have to engage with landholders in a more participatory way. The issues here are similar to those addressing environmental sustainability in these farming systems as outlined by Ridley (2004). There is a shortage of scientists who understand this new problem domain and so scientists will need to work with local people to translate abstract science into solutions that are relevant at the farm level. Such participatory approaches have been already employed by researchers in addressing a range of agronomic issues within this local community (Carberry et al., 2002). Ridley (2004) also suggests the use of a formalised Environmental Management System (EMS) process for incorporating scientific knowledge into a methodological approach for farmers to assess and improve environmental performance through continuous improvement. Such an approach could be of great benefit for farmers and CSG companies as they seek to design, manage and improve shared gas-farm systems. Success would require the development of new science, process and commitment from a range of parties.

5 Conclusions

The lessons regarding farmers' perceptions of coexistence with CSG development lie across a diverse range of problem domains. The main findings and perceptions can be summarised as follows:

- Farmers feel that the issue of place identity is not well understood by many CSG workers from non-rural backgrounds and this makes negotiations with CSG companies difficult.
- Landscape impacts can be difficult for farmers to communicate to CSG workers also because of the differing underlying value systems. Farmers see landscapes in ways that others do not.
- Farmers feel that acceptable economic benefit from CSG compensation payments could be possible if fair and equitable processes could be developed and concerns for environmental impacts addressed.
- Cultural change on behalf of the CSG companies will be required if engagement with farmers is to improve. This can be partly achieved through the use of local or rural people in direct communications with farmers. However, changes in business approaches, by both parties, would also have to occur if the adverse impacts on farmers' mental health and well being are to be addressed.
- Environmental impacts are a large area of concern for farmers. Impacts on ground and surface waters are a primary concern. A collection of issues regarding atmospheric pollution (dust, light, noise) has a significant impact on many aspects of farmers' lives. The impact of significantly increased traffic, both on and off the farm, should be addressed.
- Science, CSG and agricultural industry groups will need to work closely with farmers to develop understanding of these emerging issues and to develop solutions that are timely and relevant. Solutions may need to include formalised processes incorporating scientific knowledge into a methodological approach to assist farmers through these very important decisions.

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