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The Community Adaptability Tool - report

Securing the wealth and wellbeing of rural communities

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Community Adaptability Tool

Securing the wealth and wellbeing of rural communities

by Anthony Hogan, Dean Carson, Jen Cleary, David Donnelly, Kim Houghton,

Rebecca Philips and Robert Tanton (Eds)

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Researcher Contact Details

Professor Anthony Hogan
Institute for Governance and Policy Analysis
Building 23
The University of Canberra
CANBERRA ACT 2601

Email: Anthony.Hogan@canberra.edu.au

In submitting this report, the researcher has agreed to RIRDC publishing this material in its edited form.

RIRDC Contact Details

Rural Industries Research and Development Corporation
Level 2, 15 National Circuit
BARTON ACT 2600

PO Box 4776
KINGSTON ACT 2604

Phone: 02 6271 4100
Fax: 02 6271 4199
Email: rirdc@rirdc.gov.au.
Web: http://www.rirdc.gov.au

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or phone 1300 634 313

Foreword

Environmental and economic changes are impacting on rural and regional Australia. Drought, drying, floods and fires persistently impact on peoples' livelihoods and wellbeing. Significant policy changes for example, the Murray-Darling Basin Plan, as well as the cycle of resource booms, impact on the viability and live-ability of our communities. Rural communities are increasingly faced with the need to adapt in the face of change but they often do not have access to the specific information needed to inform their decisions. Even when the information is available, it is rarely in a form which communities find either usable or acceptable.

This project developed a methodology, the Community Adaptability Tool, for enabling communities to assess their socio-economic sustainability in the face of many change processes. This report describes 'concept testing' of the specific discipline-based (economics, demography, community development, sociology and social research) components of the Community Adaptability Tool, as well as testing of the extent to which they could produce useful socio-economic indicators which communities could use to inform their decision making. Examples have been included of the information collected in three case study sites (Waikerie, St George and Gunnedah).

The information in this report provides the methodology and concept testing to support the "Community Adaptability Tool (CAT) A guide to using the CAT to secure the wealth and wellbeing of rural communities" (RIRDC Pub No: 14/042).

This study was jointly funded by the Cotton Communities Cooperative Research Centre, the Namoi Catchment Management Authority and the Rural Industry Research and Development Corporation (RIRDC). The project was supported by RIRDC core funds provided by the Australian Government.

This report is an addition to RIRDC's diverse range of over 2000 research publications and it forms part of our Dynamic Rural Communities R&D program, which aims to improve the productivity of natural resource use and conservation.

Most of RIRDC's publications are available for viewing, free downloading or purchasing online at www.rirdc.gov.au. Purchases can also be made by phoning 1300 634 313.

Craig Burns
Managing Director
Rural Industries Research and Development Corporation

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Affiliations of members of the research team:

Dean Carson is Professor of Rural and Remote Research with the Flinders University School of Medicine, and Principal Scientist with The Northern Institute at Charles Darwin University.

Jen Cleary is the Senior Research Development Manager at the Centre for Regional Engagement (CRE) at the University of South Australia.

David Donnelly, Director, Instinct and Reason, Sydney and Canberra

Anthony Hogan is Professor and Chair of Regional Governance at the Institute for Governance and Policy Analysis at the University of Canberra, Canberra, Australia and Adjunct Professor in Sociology at The Australian National University, Canberra.

Kim Houghton is Director of Strategic Economic Solutions, Canberra.

Rebecca Philips is a Visiting Fellow at the Institute for Governance and Policy Analysis at the University of Canberra, Canberra, Australia.

Professor Robert Tanton is Associate Director and Associate Professor with NATSEM, the Institute for Governance and Policy Analysis at the University of Canberra.

Additional authors contributing to specific chapters

Jeremy Cape is Catchment Coordinator; Partnerships Namoi CMA, Tamworth.

Pele Canon is a Research assistant at the National Institute for Rural & Regional Australia, Canberra

Doris Carson is a post-doctoral research fellow at the Centre for Regional Engagement at the University of South Australia.

Stewart Lockie is Professor and Head of Sociology at the Australian National University

Sarah May is a Research assistant at the National Institute for Rural & Regional Australia, Canberra

Itismita Mohanty is a Research Fellow at the Institute for Governance and Policy Analysis at the University of Canberra, Canberra, Australia

Andrew Taylor is Senior Research with The Northern Institute at Charles Darwin University in Darwin, Australia.

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This project developed a methodology, the Community Adaptability Tool, for enabling communities to assess their socio-economic sustainability in the face of many change processes. This report describes 'concept testing' of the specific discipline-based (economics, demography, community development, sociology and social research) components of the Community Adaptability Tool, as well as testing of the extent to which they could produce useful socio-economic indicators which communities could use to inform their decision making. Examples have been included of the information collected in three case study sites (Waikerie, St George and Gunnedah).

Who is the report targeted at?

This report describes the concept testing of the components of the Community Adaptability Tool. This information provides communities and policy makers with an overview of the type of data collected when using the Community Adaptability Tool, as well as an understanding of how it may influence planning for the future.

Where are the relevant industries located in Australia?

The Community Adaptability Tool described in this report would be ideally used in communities with populations of less than 10,000 people. The case studies described in this report were completed with the Waikerie, St George and Gunnedah communities. The industries in these communities had a focus on citrus and wine (Waikerie) and cotton (St George and Gunnedah).

Background

Aims/objectives

The aim of the project was to test the economic, demographic, sociological and community development elements of the Community Adaptability Tool to ensure they provided data relevant to supporting communities to plan for their future. First and foremost, the process of engaging with the community is central to the way this tool is applied within a community setting. In addition to testing the application of this process with the tool, methods for the collection of the following data were examined:

- the economic basis for the community
- the demographic past, present and possible future of the community
- issues impacting on the sustainability of rural communities
- reasons for homeostatic failure in subjective well-being.

Methods used

Different methods were used for testing each element of the Community Adaptability Tool and are summarised below.

The engagement process

Our purpose in engaging the pilot communities was to develop a deeper understanding of their current interest in addressing change. Based on this interest we in turn worked collaboratively with the community of interest to determine the extent to which we could develop a tool that enabled the community to understand local conditions impacting on their capacity for change, while opening up possibilities for the future. This part of the project involved multiple forms of community engagement conducted at different stages of the project.

The project team drew upon the community model developed by Cheers and colleagues (2006) as a framework for ensuring comprehensive and consistent coverage of community stakeholders in each of the pilot communities. In this model, the community is represented by 11 sectors, each encompassing a sphere of human activity, such as health and human services; education and training; private sector businesses; primary industry producers; social organisation. Within this model the socio-economic infrastructure of the community was represented by three 'tiers' which comprised individuals, organisations and institutions, emphasising that community's need to be considered and understood as a system. We also recognised the inherent heterogeneity of different types of communities and the pitfalls of engaging particular privileged sub-groups. To counteract this, we drew additionally on the framework developed by Harrington, Curtis & Black (2008) in their work on identifying community types. Accordingly, we recognised that communities and sub-communities may take different forms, such as communities of place (e.g. residents of the towns within which we worked); communities of practice (e.g. fruit growers; farmers; retirees); communities of interest (e.g. arts groups; book clubs; sports clubs); and communities of identity (e.g. indigenous groups, members of particular ethnic or religious groups). Using these combined conceptions of community, the team was able to comprehensively identify the various institutions, organisations and individuals across each sector to establish a starting point for engaging within each sub-community.

The economic basis for the community

This component sought to develop a dynamic, localised model of regional economies with three important characteristics:

1. built on local specialisations (rather than assuming them away)
2. enabling realistic assessment of adaptive capacity under different scenarios
3. able to link commercial flows with community and environmental characteristics.

Interviews with farmers and farm-servicing businesses in the three case study areas provided details on the supply chains in each area. Subsequently, local economic adaptation was modelled based on a local production systems approach which draws on data collected from local growers, crop handlers and value-adders on their scale of operations (including employment), the factors that determine this, and the main upstream and downstream links in the supply chain.

The demographic past, present and possible future of the community

A multi-faceted approach to demographic modelling was employed:

1. baseline analysis of gross demographic change (total population, age and sex) using existing census, estimated resident population and population projections data. The analysis was conducted across whatever timeframe for which data were available

2. baseline analysis of patterns of migration in to and out of the case study communities between 2001 and 2006

3. identification of key drivers of demographic change based on rural demographic theory and input from the primary data collection and community engagement components of the Securing the Wealth and Wellbeing of Rural Communities project

4. construction of agent based models of community populations that allow exploration of the potential demographic impacts of changes in the economic and social characteristics of the community over the next 15 to 20 years

5. testing of the demographic analysis with key informants in the case study communities.

Issues impacting on the sustainability of rural communities

This component of the project involved a 20 minute computer aided telephone interview survey of 2000 respondents from across the three areas of interest; Waikerie, Gunnedah and St George. The main components of the survey were:

1. subjective wellbeing (Cummins 2009)

2. basic index of recent stressful events

3. financial and emotional impacts of significant weather events

4. questions on individual adaptive capacity (Schwarzer and Jerusalem 1995) ,

5. questions on collective adaptive capacity including community leadership (Paton, Burgett and Prior 2008)

6. social connectedness (Bhutan 2012; McIntosh et al. 2008; Cummins et al. 2003; Salvaris 2000)

7. work life balance (Karasek 1979)

8. state of natural resource condition (Namoi Catchment Managements Plan)

9. water usage (Namoi Catchment Managements Plan)

10. demographic items

11. a discrete choice model which examined a series of six possible rural scenarios. Residents were asked to decide on the basis of scenarios, whether or not they would stay in or leave the community.

Reasons for homeostatic failure in subjective well-being

The resilience of human systems is of great interest to community leaders and policies makers who are concerned with the capacity of stressed communities to be able to respond to change in a positive and sustained manner. We approached this challenge through a social psychology and public health lens where human resilience was understood as having the capacity to maintain wellbeing in the face of significant life stressors; the loss of this capacity was identified by Cummins (2009) as homeostatic failure. Since an analysis of homeostatic failure requires access to longitudinal data, data from the Household Income and Labour Dynamics in Australia (HILDA) survey was used. An analysis of these data enables one to identify the group of people who have experienced homeostatic failure from one wave to the next of HILDA. Changes in social capital and life events experienced by these people over

these two waves are calculated. A logistic regression model is then used to identify which of these changes have a significant effect on homeostatic failure.

Results/key findings

The projects described in this report tested the components of the Community Adaptability Tool to a level at which they are usable and reusable by the project team to generate believable scenarios for local futures. Key findings related to each of the components are summarised below.

The engagement process

This project highlights that there is no 'one-size-fits-all' prescriptive process that enables engagement to occur, and that a variety of tools and mechanisms that are fit for specific purposes and local conditions must be considered. However, we support the view that recognising and embracing a set of guiding principles is an effective starting point. What matters most is that the engagement strategy meets the needs of local stakeholders and communicates outcomes back to the community as an ongoing process, which may (and should) continue beyond the immediate phase of data collection. For this project, deep engagement embedded in social processes and trust relationships has been integral to the achievements of the project to date. This has entailed a long-term commitment to the communities that the project team has been working with, and the recognition that determining clear and consistent engagement leadership at the commencement of the project has been a critical success factor. We also recognise that engagement has been mutual, in that community members have been integral to the development of the research process and outputs, and that the process has not been extractive but contributed substantially to building community capacity. Finally, we wanted to emphasise and acknowledge that successful engagement is not measured by those seeking to engage, but by those with whom one is seeking to engage.

The economic basis for the community

It is apparent that in modelling local economic activity in these three rural study areas, the main players in the supply chains are experienced in handling variability in agricultural activity levels, and that there is not a simple, linear relationship between planting, harvest and local flow-on spending. In particular, it is not accurate to predict flow-on spending by growers, or employment levels on farms or processing businesses, as a fixed proportion of areas under crop. There is a tipping point for grower and business adaptation between 25% and 50% reductions in water availability, with practices for both groups changing significantly across this boundary.

The demographic past, present and possible future of the community

The demographic modelling for the Community Adaptability Tool is designed to be underpinned by, and to facilitate, a 'demographic discussion' with communities. Community aspirations and apprehensions for the future are often couched in demographic terms related both to gross population change and specific types of population change. The baseline demographic analysis allows the project to explore the context in which scenarios identified by the community as important to their future might occur. It provides a method for testing the responses to the community survey (specifically responses relating to out-migration intentions) and it 'fills the gaps' in survey information by assessing patterns of in-migration, births and deaths. At least as important as all these functions is the demographic modelling as a contribution to the community from the project. The experience in Waikerie highlighted the value that community members attach to having existing social and demographic data about them interpreted in the context of their aspirations and apprehensions.

The 'demographic destiny' for each rural community is in part determined by its history, but is also linked to the unique set of contemporary circumstances that face each community. As a result, we need more than standardised demographic modelling tools to try and envisage how a community might look in the future.

This project compared the demographic characteristics of three rural towns to illustrate how diverse those characteristics can be, and how diverse the influences on demographic change can be. We propose using an agent based demographic modelling approach to both account for the unique characteristics of each community, and to allow us to explore different scenarios for the future. For example, residents and visitors to a community will behave differently given the presence or absence of certain facilities (health, education, shopping etc), and will react differently to future states (increased or decreased economic activity, changes in population structures etc). A trial of agent based modelling for Waikerie showed that changes which are seen as negatively impacting the community have dramatic consequences in terms of population loss, while changes seen as positively impacting the community have more moderate impacts on population gain. Other communities will react differently to the events we have modelled for Waikerie (perhaps more responsive to population gain events rather than population loss events, for example), reinforcing the need to customise demographic analysis for each community.

Issues impacting on the sustainability of rural communities

In the face of constant change, members of rural communities are faced with the ongoing need to adapt. Be it changes in the environment, social relations, social policy or the economy, new challenges persistently emerge and shocks frequently arise. Given such a culture of challenge, policy makers are increasingly concerned with the extent to which people living in rural and regional Australia are able to adapt and maintain their wellbeing. This study takes up this question, examining questions of adaptability and human wellbeing. The studies were undertaken with the support and collaboration of three rural communities, the Namoi region in New South Wales, Waikerie, in the South Australian Riverlands and St George, in southern Queensland. In addition to the impact of ongoing global economic transformation, each of these have been facing their own challenges as a result of a very long and deep drought (2001-2010), changing social policy concerning access to irrigated water, several floods in recent years and the environmental impacts of climate change and human activity. The study addressed five basic questions concerning aspects of adaptability which may impact on the social sustainability of rural communities:

1. how are people faring with regards individual and collective adaptive capacity
2. how are people faring with regards with regards their wellbeing and to what extent is wellbeing related to individual and collective adaptive capacity?
3. is there a relationship between human wellbeing and outcomes in natural resource condition
4. understanding differences in adaptability at the local level
5. the potential impact of access to services on the sustainability of rural communities.

The overwhelming insight arising from these studies is that local communities see themselves as having high levels of individual and collective adaptive capacity, and they enjoy high levels of social support and wellbeing. Specific insights include:

- 86% of community members report high levels of individual adaptive capacity
- 80% report being able to work together as a community to solve the challenges they face in adapting to change
- 79% report feeling safe
- 72% report positive wellbeing
- 55% report enjoying high levels of social support

- 55% report having experienced no significant or major life stressors in the past 12 months
- 51% reported high levels of confidence in their local community leadership
- community wellbeing is underpinned by feelings of connectivity, the ability to work together to solve problems and enjoying access to social support.

Notably, the study examined the question as to whether people, in the face of persistent stressors, faced a threshold or tipping point in subjective wellbeing. The cross-sectional nature of this study prevented us from drawing a causal conclusion on this issue. We could however observe an association between adaptive capacity and subjective wellbeing. The results of an additional project, which utilised longitudinal data, did identify a tipping point in human wellbeing (see Tanton et al. 2012), although it did not specifically address adaptive capacity. These insights provide a basic justification for the development of a longitudinal study which examines adaptive capacity and wellbeing.

Similarly, members of these communities show strong support for the environment:

- 82% support sharing of water resources for the environment as well as industry and human uses
- 59% reported that positive natural resource outcomes had been secured in their region
- a relationship between natural resource condition and human wellbeing was observed in the study.

Just as no two rural communities are the same, people living within rural communities are also not all the same. With regards adaptive capacity and wellbeing, our analysis identified four distinct groupings within our communities:

- local leaders who lacked community support (30%)
- capable individuals disconnected from their broader community (22%)
- country residents doing well (37%)
- residents at risk (11%).

Members of the first segment (30%) reported strong community leadership and the capacity to work together but below average adaptive capacity, connectivity, individual adaptive capacity and wellbeing. Primary producers were well represented in this segment as were women and people living in Waikerie. Approximately two-thirds of this segment was in some form of full time paid employment. They enjoyed good job security and felt they had employment options should they lose their current job. Notably more than one third would retire if they lost their current job. Climate events, particularly droughts had financially as well as emotionally impacted on this segment. They report as being in good but not excellent health. A small proportion of this segment (3%) reported scores below the threshold for homeostatic failure in wellbeing. They are highly involved in church and sporting groups.

Members of this second segment reported above average levels of individual adaptive capacity and slightly above average wellbeing while reporting below average scores on the other indicators. Respondents' from the Waikerie community were under-represented in this segment while respondents' from the Namoi community approached statistical significance for being over represented in the segment. Members of this segment were more commonly men, to be aged over 55 years, although no one particular participant or industry type was more common than others. As with other segments, agriculture was the main employer. Members of this segment were also more likely to be living in shared accommodation and a disproportionate number reported earning incomes in excess of $120,000 per annum. A small proportion of this segment (4%) reported scores below the threshold for homeostatic failure in wellbeing. As with other groups, if they lost their jobs one third would retire but

a large proportion (12%) considered that they would need to leave the area to find further employment. Members of this segment were less likely to be involved in church activities. Taken together these indicators paint a picture of capable individuals who lack community connectivity and support and who are vulnerable to change, particularly in agriculture.

Members of the third and largest segment (37%) reported members above average adaptive capacity, connectivity, social support, ability to work together, community leadership and wellbeing. They are more likely to be town residents. While no single community stood out, the St George area trended towards being predominant in this segment. There were no significant differences in this segment by gender. However, this segment did enjoy an over-representation of gouger people. Two thirds of this segment is in some form of full time paid employment; they reported the highest levels of job security, and were commonly working in agriculture, health services or education. Unlike other segments, these respondents were very positive about their capacity to find another job n the area, if they needed to. The segmented had an under-representation of trades people. Members of this segment reported being less financially or emotionally impacted by drought and flood events. They report the lowest mean level of cumulative stressors. They reported the best health of all the segments and the also reported a higher proportion of people in the highest income level (although this difference was not statistically significant). This segment had the lowest proportion of people (1%) who reported scores below the threshold for homeostatic failure in wellbeing. They were more likely to live households with no children and they reported above average levels of involvement in churches and sports clubs.

Members of the fourth and smallest (11%) segment report below average scores on all the social indicators examined in this study. They report experiencing below average of adaptive capacity, the ability to work together, community connectivity and leadership, social support and subjective wellbeing. Members of this segment were equally represented across both respondent types as well as the participating communities, save for the factor that they lived in their communities for an average residency of 19.1 years compared with the average of 22.3 years. Members of this segment were the most vulnerable in the workforce. They reported the lowest rate of full-time employment and were notably over-represented amongst the casual workforce. They were also over-represented amongst those with TAFE and equivalent qualifications. As well, they were more likely to be physically unable to work or to be unemployed. Those in work reported the lowest levels of job security and were more likely to report that work and family life interfered with each other and that they were dissatisfied with the amount of leisure time they had. If they lost their job they expected that it would be more difficult than others to find another job locally. They reported the highest cumulative life stressors and the worst health. More than half the segment (56%) reported scores below the threshold for homeostatic failure in wellbeing. They were more likely to be in households of single people aged over 30 years and were over-represented within the two lowest income groupings. They were less socially connected being more likely to not be involved in either church or sporting groups.

In the face of potential changes to the local economic base and employment opportunities, local community members reported being highly resilient to changes in employment opportunities. Over one third reported that they could readily find alternate forms of work or business while very few people (9%) saw themselves as having to leave their district due to employment problems. One adaptive factor however will bring notable change to these communities should employment opportunities change. Reflecting the ageing nature of rural communities, one third (35%) said that if they lost their jobs they would just retire. The impact of such a change on local economic and social flows warrants further investigation. Notably, for people aged over 55 years, 46% work in agriculture and 13% in health and social services. For people aged over 65 years, 69% work in agriculture.

- Finally, respondents were asked to consider scenarios regarding access to local services and support, which would influence their decision to stay in rural community. Three key drivers of local community sustainability were identified:

- access to health services (52%)

- access to education (21%)

- access to community and social life (17%).

Reasons for homeostatic failure in subjective well-being

Two major life events affect the probability of homeostatic defeat. Having a baby reduces the probability of homeostatic defeat, and separation (from a partner) also increases the probability. Worsening health status and decreasing leisure time also have a significant effect on increasing the probability of homeostatic defeat. Income is also a protective factor for homeostatic defeat, reducing the probability slightly. Interestingly, major life events like death of a relative and death of a child had no significant impact on homeostatic defeat, so homeostasis continues to support wellbeing after these major life events. This work reinforces the impact that separation has on a person's wellbeing, and the impact on the rest of a family's wellbeing that a new baby brings.

Implications for relevant stakeholders

Grounded within a process of community engagement, this project has examined communities from four perspectives: their economics, demographics, issues impacting on their sustainability and reasons for homeostatic failure in subjective well-being. By documenting data related to each of these perspectives believable scenarios were able to be generated for local futures. The use of these elements within the Community Adaptability Tool will support communities to identify existing data sources and learn how they can use this data to inform planning for their future.

Recommendations

The next step is to validate the use of the Community Adaptability Tool in additional case sites, particularly those without an agricultural focus, and promote its ability to support communities makers in planning for their future.

Chapter 1 - Introduction

Authors: Anthony Hogan, Dean Carson, Jen Cleary, Kim Houghton, Rebecca Phillips, Robert Tanton and David Donnelly

Background

Significant change is occurring in rural and regional Australia, particularly in eastern Australia. Much of rural and regional Australia has only recently emerged from a ten year drought which affected communities' right across the Murray-Darling Basin. The drought impacted not just on the viability of agriculture and rural towns but on the viability of many river systems and the eco-systems which they support. The significance of the drought generated a policy re-think on the use of irrigated water for industry, taking into account climate change. The result of this policy work has been the development of the Murray-Darling Basin Plan which was finally signed in late 2012. The proposed plan was seen to threaten the viability of a variety of agricultural industries and the communities which depend on such industries for their livelihoods. Various statistical models were put forward which presented the likely impacts of the Plan on various rural communities (Marsden Jacob Associates et al. 2010b; Stubbs et al. 2010).

In addition to addressing the economic impacts of the Basin Plan, some of these studies also began to address the social impacts of policy and environmental change. The findings of some of the studies were strongly contested within the community and the scientific community. Similarly some of the engagement processes that had been initiated exacerbated tensions between interests.

While there was much debate about the meaning and impact of a Basin Plan at a national level, issues also began to percolate at the local level. It rapidly became apparent that specific communities did not have access to the data they needed to inform their decisions, the data was not in a useable form or the data was not produced by a trusted source. Within a contested policy space, any of these issues served as a significant barrier to effective engagement.

These processes played out over several years. At the same time the Cotton Communities Collaborative Research Centre had convened the first of three community conferences which were concerned with the question of the sustainability of rural communities. The issue of the accessibility and useability of local level data arose at this conference. At the same time, analysis commissioned by the Namoi Catchment Management Authority (Namoi CMA) identified that adaptive capacity and social wellbeing were critical factors which impacted on important environmental processes across their catchment area (Cork et al. 2011).

It was from within the intersection of these quite distinct processes that the need for this project was born. Communities were seeking information that they could use to inform their participation in policy development processes. To sustain themselves, stakeholders saw that rural communities were increasingly faced with the need to constantly adapt in the face of change, irrespective of whether the change was driven by competitive economic pressures demanding ever greater productivity, globalism, technology development or climate change.

Adaptation which secured socioeconomic viability and environmental sustainability in the face of constant change meant that communities required an adaptive capacity that involved the presence of community development and environmental values, the human ability to engage in change, and a viable local economic base with sufficient flow on values and job generation capacity. Inherently, communities would possess these attributes to differing degrees. However, what was noticeably absent was the opportunity for communities to readily assess where they stood in relation to these attributes

and how any specific proposed development or disruption of their economic or environmental base, may impact on their community and their wellbeing or vice-versa.

To this end this project examined four aspects of adaptability which may impact on the sustainability of rural communities: (i) individual and collective adaptive capacity (ii) social wellbeing (iii) biodiversity and water sharing, and (iv) factors which might drive people to leave their community. Additional studies conducted in conjunction with this work address role of community leadership in supporting adaptation in the face of change (Carson & Cleary 2012), the structure of the main economic flows which underpin the viability of livelihoods within these communities (Houghton & Fell 2012), demographic projections (Carson et al. 2012) and homeostatic failure in human wellbeing (Tanton et al. 2012). These projects are the focus of this report and are described in detail.

It is a given that extensive social, economic and environmental change is occurring across country Australia. Despite the bright future which lies before us (e.g. the so called *dining boom* where Australian produce will be increasingly exported to Asia), in the short term there is a great deal of discussion about the viability of localised productive efforts. Many community leaders remain up-beat about both the viability and liveability of their communities. Nationally, through the Regional Development Australia Fund, and subsequent joint investments from state and local governments and industry partners, literally billions of dollars are being spent on up-grading infra-structure to support the nation's transition to more sustainable forms of rural production. The Murray Darling Basin Plan alone is contributing billions of dollars to water infra-structure development and related projects. The future is promising. With the Australian Government making a significant commitment to the future of country Australia, rural communities are keen to make the most of these opportunities to secure funding for projects which are vital to ensuring their futures. And while there is no shortage of good ideas or willing partners, communities have lacked access to data which can be used to help them to identify and justify which projects are most worthy of funding support. This project was designed to develop a way for country communities to work together, in a process championed by local people, to understand how their local economy works and the opportunities it may present for the future and in turn, engage in a process for planning their futures, which is evidenced informed. To this end this project set out to develop a methodology for enabling communities to assess their socio-economic sustainability in the face of many change processes. We have entitled our project the Community Adaptability Tool. This report describes 'concept testing' of the specific discipline-based (economics, demography and sociology) components of the Community Adaptability Tool, as well as testing of the extent to which they could produce useful socio-economic indicators which communities could use to inform their decision making.

The foundation and driving principle of the project is that the wealth and wellbeing of a rural community is dependent on the specific circumstances that apply in that community. A key tenet held by the working group which undertook this project, is the adage that 'if you've seen one country town; you've seen just one country town!' A one size fits all approach to socio-economic sustainability is unlikely to be applicable to every community, given that each community has access to differing assets (such as soils, climate, proximity to transport hubs, human capital and so on). Similarly each community inherits a different history, has different expectations for its 'wealth and wellbeing', and is subject to different social, political, cultural, economic, environmental, and demographic forces. Consequently each community has different potentials for its future. This project recognises the individuality of communities and incorporates community specific (inside) information alongside the secondary sources (outside) of information that normally drive local area modelling exercises.

At the high level (see Figure 1), the tool identifies a set of key scenarios around the vulnerability and potential of the community, and then uses psychographic, economic and demographic modelling techniques to illustrate what impacts each scenario may have on the wealth and wellbeing of the community over a period of 15 to 20 years. The model outputs are not proscriptive - the tool produces different results depending on the combination of factors that comprise a scenario, the timing of the scenario, and the starting economic and demographic conditions. For example, a community may experience different impacts from the closure of a key local business depending on when that closure

occurs and what else is happening at the same time (other businesses opening/ closing, different types of in-migration or community leadership structures). Random local effects (weather events or exposure to exogenous factors) can also mean that a community theoretically experiencing the same event at the same time with similar internal conditions can experience different outcomes. What the tool therefore does is allow communities to explore the range of outcomes that may be possible from various scenarios. Gaining insight into these issues gives communities a powerful capability when engaging in discussions with government and other external stakeholders who are usually limited to consider one future state (derived from formal population projections, or economic input-output models, for example).

Figure 1 A scenario developed for the Waikerie study

The package gives each community the ability to look at different future scenarios, and then work back to see the key ingredients and tipping points that got them there. It allows communities to map much more closely the outcomes of changes in circumstances (environmental, economic or social), or of values and see how these influence the end outcome. Communities will already have a feel for changes that they can readily adapt to (the nature of these as well as their extent) and those which the community is less able to adjust to. However, there are times when a 'the community doesn't know what it doesn't know'. For example, during our concept testing work, one community assumed its economic viability pivoted on agriculture. But the analysis showed that in fact it was the presence of some specific government institutions that was at the heart of the process which put in place the economic multipliers central to their viability. It is very important then that local insights be informed by locally relevant data. Similarly, our process develops data sources which are informative of where the community is presently at. National data sets e.g. HILDA dataset) are very useful at a national level. They can inform us about adaptive capacity and social capital and so on. But these data are not collected at a local level. Without additional data collection it is very difficult to really understand how a local community is operating.

These days we hear an enormous amount about resilience, adaptive capacity and local leadership and how important these factors are to community sustainability. But what if the assumptions about these indicators are truisms? What if, as our preliminary work as reported herein shows, that all three indicators are strongly present in all communities? What if the question about sustainability for a given community has little to do with the human capabilities of the community but rather is driven by structural socio-economic factors (e.g. the community was established to service an overland telegraph and telegraph service no longer needs servicing!) A community can be as active and responsive as they like, but if they do not have an economic base to draw upon, then on what basis would they secure their economic future? Similarly, it may be the case that within a given community issues about human and social capital are central to sustainability. Imagine the case, as is evident in our preliminary studies, that there are people with great ideas and energy, who can and want to contribute to helping a

community grow, but they are locked out of the decision-making process! By following our process, a community can identify the relative scale of importance of these 'scenario drivers' – each set of which will be unique to each community. It helps communities to see how much they will be able to 'roll with the punches,' while also helping them to identify the kinds of futures they are seeking and the kinds of support they may need to get there.

Our approach is based on understanding that each package of local social, environmental and economic capital circumstances are central to the community's outcome. We do not assume these differences away. We examined differences in rural communities by comparing them on the indicators considered in this study, specifically individual and collective adaptive capacity, community leadership, support for biodiversity and water for the environment and wellbeing. Similarly, a critical issue impacting on the viability of rural communities is population drift. We take up this issue by examining, from a community perspective, the issues which community members regard as being central to their continuing to live in their communities.

Next steps

This project developed a methodology, the Community Adaptability Tool, for enabling communities to assess their socio-economic sustainability in the face of many change processes. The tool is now undergoing an extensive evaluation within a new test site, with the evaluation due to be completed in June 2014. Notwithstanding the evaluation, the tool is now at a stage where it can be used in local communities to source relevant data and inform its use in planning for the future. The purpose of this report has been to provide stakeholders with access to the tool and the thinking behind it, so that the benefits of this research can be readily accessed by the community. We trust that you will find the tool of interest and use in your community and look forward to being in touch with potential end-users who would like to apply the tool within their community setting.

2. An overview of the Community Adaptability Tool

Authors: Dean Carson, David Donnelly Rebecca Phillips Jen Cleary, Kim Houghton, Robert Tanton and Anthony Hogan,

The aim of the project was to 'concept test' the specific discipline-based (economics, demography and sociology) components of the Community Adaptability Tool, as well as testing of the extent to which they could produce useful socio-economic indicators which communities could use to inform their decision making. In particular, collection of the following data was examined:

- the engagement process
- the economic basis for the community
- the demographic past, present and possible future of the community
- issues impacting on the sustainability of rural communities
- reasons for homeostatic failure in subjective well-being.

In this Chapter the reader can see an overview of the Community Adaptability Tool. The results and implications of concept testing each component are described in Chapters 3-7.

The Community Adaptability Tool facilitates communities through an eight stage process in which they identify existing data sources and learn how they can use this data to inform planning for their future (see Table 1). At the end of the process the community understands how they can work towards a shared vision for the future by managing competing priorities within a limited resource base.

Table 1 The eight stages of the Community Adaptability Tool

Stage One (Pre-engage)	**What has been happening to the community so far?** • The project team develop an insight into the issues facing the community by reviewing economic data, demographic data, local reports, council minutes and newspapers.
Stage Two (Inside knowledge)	**What is the community's story?** • The project team talk to members of the community to identify local 'aspirations and apprehensions'.
Stage Three (Outside knowledge)	**What are our options?** • Review the information which is already available and bring in information to understand how other communities have responded to the issues that your community is facing.
Stage Four (Visioning – realistic scenario development)	**What is the capacity of the community to adapt?** • Community members complete a survey to identify the capacity of the community to manage change, taking into account their health and wellbeing. Is there enough support for our leaders? Are people burning out? Are some people especially vulnerable to change?
Stage Five (Scenario testing)	**What will I do in the face of changes?** • The community develops 4-6 scenarios for the future based on local aspirations/apprehensions and observations from similar communities. For example, what would happen to our community if the local mill closed? How many people would leave?
Stage Six (Modelling)	**Production of a decision support tool** • The project team develops an interactive computer-based tool to predict how the community may respond to changing circumstances. The community is trained so that they can use the tool themselves on an ongoing basis.
Stage Seven (Presentation)	**Community engagement with the decision support tool** • The project team and the community discuss the findings from Stage Six and consider how they can be used in planning for the future, in particular how different results might be possible from similar interventions, e.g. whether employees at the new manufacturing business choose to live locally or commute from other places.
Stage Eight (Knowledge transfer)	**Taking action** • The project team work with the community to identify where action can be taken.

Stage 1 – What has been happening in the community so far?

This stage involves preparation for interacting with the community. It includes gathering readily available secondary data (census data, for example), and reviewing local reports, council minutes, newspapers and so on to get an initial view of what issues are confronting the community. From this view, we prepare a draft report (in poster or presentation form) about what external data says about the issues, and how the same issues may be affecting other communities (see Figure 2).

In parallel, the process involves identifying one or more key contacts within the community who will guide the process locally. Key contacts are normally expected to have access to one or more community based groups or committees, local media, and local political leadership. Key contacts review the draft report, offer their own advice on interpretation of local issues, and arrange for a more formal presentation of the report and the project purpose within the community.

Finally in this stage, members of the research team visit the community and informally introduce the research to casual contacts that are made as part of being in the community for several days (store owners, hotel managers, cafe and restaurant staff and so on). Again this is aimed at developing a deeper understanding of local issues that can inform the way in which the project and the already accessed secondary data are presented to the community.

Figure 2 Example (part) of draft poster report from pre-engagement stage of Waikerie study

Stage 2 – What is the community's story

In this stage, there is a more formal process of collecting information about local issues, visions and perspectives. Once the project has been introduced and key contacts are in place, we conduct a series of interviews with local informants (business owners, farmers, community group members etc) aimed at gathering more detailed documentation of local "aspirations and apprehensions" about the community. The community sectors model is used to ensure informants are reached from across all community sectors. Snowball sampling is also used in this stage. Where do local people think the community is headed? What are the key triggers for positive and negative change? What changes have been observed locally? What are the visions for the future (formally and informally recorded)? These interviews gather data of a social and economic nature, as well as identifying any significant environmental issues which may impact on community sustainability and are based on the Community Capitals Framework. The interviews with businesses along the community's most important supply chains will show how businesses have adapted in recent times and will be used to prepare a 'bottom up' model of the foundations of the local economy. The model will be reality checked against recent experiences in the community, and then used to understand the likely economic impacts of the next round of challenges.

As at all stages, the process of taking information from the community is paired with a process of giving information (updating the draft report on secondary data, making a public presentation of progress) (see Figure 3).

Aspirations	Apprehensions
• Retain young people in town and attract families with children to slow down population ageing • Attract university graduates back to town • Attract skilled workers (especially in the trades and health sectors) • Increase attractiveness for lifestyle retirement • Harness multiculturalism to attract visitors and migrant communities	• Impact of mining on local housing and employment • Increase in non-resident workforce • Outmigration of young people leading to acceleration of population ageing • Declining number of community volunteers • Difficult to attract and retain professionals in key service sectors (health, education, police)

Figure 3 Aspirations and apprehensions in Gunnedah, Namoi Catchment

Stage 3 – What are our options?

This is the ongoing task of matching local issues and observations to what we can know about the community from secondary data sources. It also involves literature reviews aimed at understanding how other communities have responded to the issues that this community is concerned about.

Stage 4 – What is the capacity of the community to adapt?

The heart of the research is the exploration of specific scenarios of change. "What if"... water allocations for irrigation are reduced? ... there is an increase in tourist traffic? The local hospital is closed or services downgraded? A new manufacturing business moves into the region?

These scenarios are drawn from the local intelligence, regional and local development strategies, observation of events occurring in analogue communities (communities identified through the data and literature as facing similar challenges) and so on. An initial set of anywhere between six and twelve such scenarios are developed for discussion with the community.

Communities will be encouraged to consider 5, 10 or 20 year visions for their future which will incorporate some of the changes they are currently going through, based on different scenarios as to where these changes will take them. So the scenarios won't attempt to second guess the actual future, rather they will gather thoughts on 'what would happen if …' and incorporate the consequences based on what we know about the community. For example what would be the outcome of a population growth scenario, or a population decline scenario? Or a climate change or energy cost change scenario?

Scenario testing will enable communities to look at the trade-offs between different futures – such as congested traffic from a boost in population, or a shortage of jobs in social services and aged care if mid-career trades and professional jobs in other industries go while the older population increases. It will also enable communities to see what some of the key tipping points are, what they lead to, and to identify the characteristics of their community that need to be nurtured to achieve the preferred future.

The scenarios also enable communities to see what the actual local response will be to possible external pressures. How might employment change if water availability is restricted, for example? Or what about local spending patterns – how might they change with a good or a bad crop yield? What would be the flow-on effect of a local processing factory (cotton gin, flour mill, abattoir etc) closing – or expanding? Or of a new technology that meant new crops could be grown profitably?

In this way the scenarios will enable communities to better understand where they are going, and what they need to do to achieve their preferred future.

Stage 5 – What will I do in the face of changes?

The initial list of scenarios is presented to the community via public presentation, circulation via key contacts etc. Feedback is sought on whether these scenarios appear relevant. The scenarios are also discussed with key regional figures (such as Regional Development Australia, representatives of state and national government agencies). There is an iterative process of scenario development and testing until a set of scenarios of key interest is agreed (see Figure 4).

Once the visioning scenarios are developed then more detailed, community specific, future scenarios are developed that allow an everyday community member to respond. These scenarios are brought down to very simple set of circumstances that any community members might be faced with. These are framed within the realistic bigger picture visions that the community have told us they could see happening in their town in Stage 4 so that they are anchored in a world of probable futures that the community understand and aspire to.

Most importantly all communities talk about whether the community will grow or fade away. Hence staying or going is central to the future demography of the community.

Figure 4 A scenario developed for the Waikerie study

Once a set of scenarios is agreed, a community wide survey is conducted asking how the scenarios would influence individual, household and family behaviour (see Table 2). Community residents are asked about their current plans to stay in the community or move to somewhere else. They are asked about how these plans might change under the various scenarios. Results from the survey also provide for the development of psychographic profiles (made up of data on social and psychological wellbeing, and socio-economic indicators) allowing sample results to be benchmarked to the total population.

Table 2 Extract of community survey

	Not at all true (1)	Hardly true (2)	Moderately true (3)	Exactly true (4)
I can always manage to solve difficult problems if I try hard enough (1)	☐	☐	☐	☐
If someone opposes me, I can find the means and ways to get what I want (2)	☐	☐	☐	☐
I am certain that I can accomplish my goals (3)	☐	☐	☐	☐
I am confident that I could deal efficiently with unexpected events (4)	☐	☐	☐	☐
Thanks to my resourcefulness, I can handle unforeseen situations (5)	☐	☐	☐	☐
I can solve most problems if I invest the necessary effort (6)	☐	☐	☐	☐
I can remain calm when facing difficulties because I can rely on my coping abilities (7)	☐	☐	☐	☐
When I am confronted with a problem, I can find several solutions (8)	☐	☐	☐	☐
If I am in trouble, I can think of a good solution (9)	☐	☐	☐	☐
I can handle whatever comes my way (10)	☐	☐	☐	☐

Stage 6- Production of a decision support tool

The modelling processes are undertaken using the total range of data gathered in the project.

Choice modelling extrapolates the community survey results to the total population, and allows individual scenarios and combinations of scenarios (e.g. the secondary school closes and a new manufacturing business opens) to be tested in terms of the choices community members would take to stay or leave the community (as per Figure 4).

Demographic modelling examines how the scenarios (and their social and economic impacts) might result in changes in the demographic profile of the community. How many people, and what age and sex structure might emerge over the next 15 to 20 years, and how might this be different from current and past profiles?

Social modelling examines how the various scenarios might impact the strength of the community in terms of leadership, capacity to adapt to changing circumstances, social networks and connections.

Economic modelling examines how the various scenarios might impact on the strength of the community in terms of its economy – the employment mix, spending patterns and business prospects.

The modelling stage also involves assessing survey responses in light of what we know to have occurred in similar circumstances in analogue communities. This is important because people often are uncertain about how their life plans might change in the future. Where there are apparent disconnects between community responses and observations from analogue cases, we are able to use our insights from the data collection process to adjust models accordingly.

Stage 7 – Community engagement with the decision support tool

Results of the modelling are presented in report and seminar form and discussed with the community. One of the strengths of the modelling approach is that it allows different outcomes to emerge from apparently similar circumstances. The community can then be included in examination of why different results might be possible from similar interventions (whether employees at the new manufacturing business choose to live locally or commute from other places, for example).

The presentation process also allows the community to identify new scenarios and combinations of scenarios that are considered worth investigating. In many cases, the choice modelling approach allows these to be tested without re-administering the community survey.

Samples of presentation of results for Waikerie study

Choice Model

Choice modelling allows a prediction of how communities might respond to changing circumstances of the community in terms of whether they would stay or go. Figure 5 represents a hypothetical scenario that community members responded to and that allows prediction of staying and going (by community segment).

	Stay	Go
Full time work	Levels of full time work remain about the same	
Part time work	Levels of part time work are increased	
Young people leaving	There is an increase in the number of young people leaving the community	
The numbers of women (young and old)	The numbers of younger women declines while the numbers of older women remains the same	
Family and friends	Some family and friends have moved away	
Population change	Population remains as about the same (newcomers replace those who leave)	
Community and social life	The local sporting teams can no longer continue	
Education services	The local schools remain as they are	
Health services	The current level of health services and doctors and/or nurses in the community remains the same	
Aged care	The level of aged care services is maintained	
Local businesses and employment	Some businesses and shops close but new and/or different businesses open	
Tourism	Tourism increases	
New Share	78.91%	21.09%
Base Share	82.75%	17.25%
Change	-3.83%	3.84%

Figure 5 A hypothetical scenario for Waikerie using choice modelling

Demographic Model

The demographic model makes a prediction about how such changes may impact the demography of the community in 10 to 25 years' time (see Figure 6).

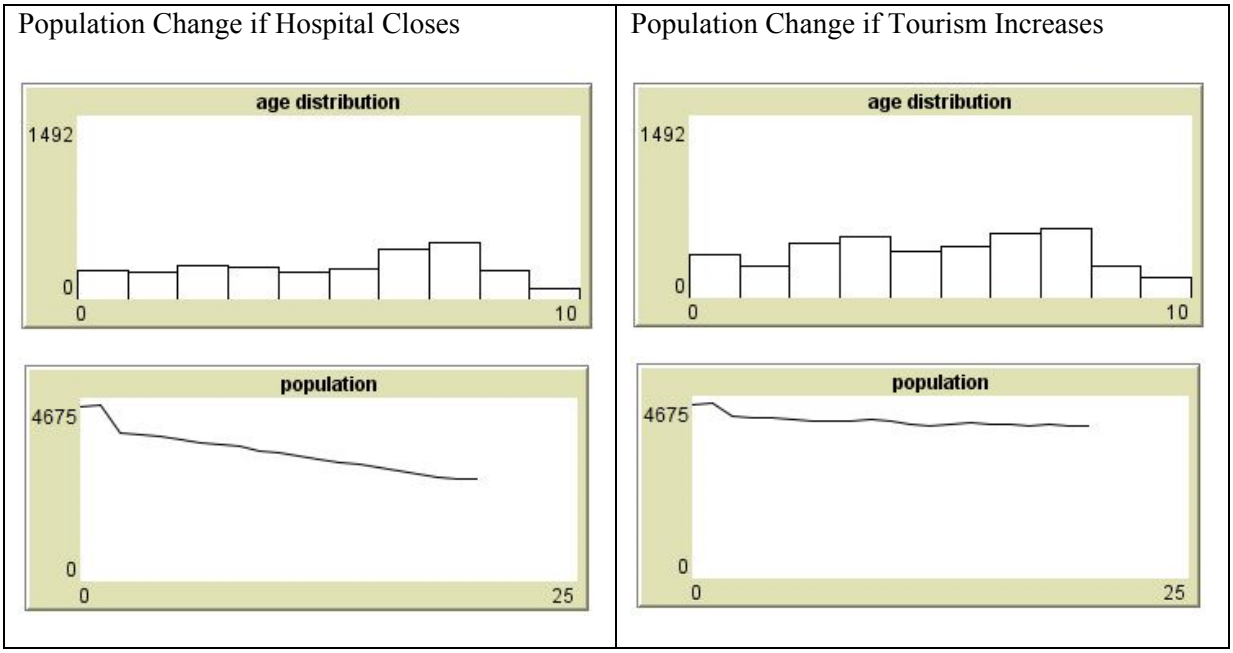

Figure 6 Demographic model for Waikerie

The choice model and demographic model work in concert to show how changes to a community's situation will be likely to result in people leaving. The choice model also identifies who leaves (whether it is families or older people). As a result the data then feeds the demographic model to make a prediction about the demography of the community in 10-15 years' time.

This allows communities to identify how changes occurring in their town today may impact in 15 years' time. It allows the community to take action to create a different future for their community.

Social Model

A key focus of the process is identifying the relationship between social indicators and wellbeing. In particular, communities need to know whether humans face tipping points in wellbeing. Just as it is evident that many rural communities are prospering, it is also evident that not everyone within a given community is doing well. Communities are made up of sub-groups of people whose risks and therefore whose subjective wellbeing, will differ.

The process uses five key social indicators used as the basis for the segmentation analysis:

- individual adaptive capacity
- ability to work together
- social support
- community leadership
- subjective wellbeing.

Figure 7 shows the results for one community. In determining the social vulnerability the size of each segment is of critical importance as is the make-up of the various social indicators.

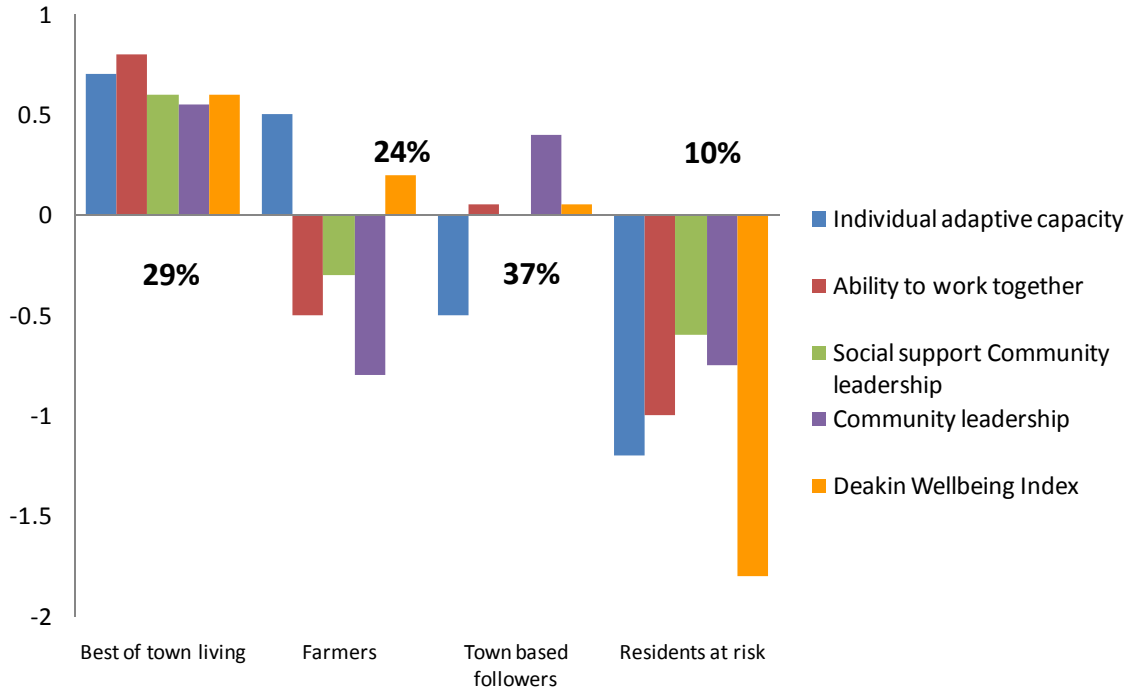

Figure 7 The capacity of community members to deal with change

A score of zero means average capacity to adapt on the indicator shown. Scores above the line represent above average and below the line, below average outcomes. Taken together, the indicators give an idea of the capacity of different segments within the community to adapt to change.

Economic Model

The economic model is based on a series of interviews in the local community that maps the economic flows and supply of jobs (see Figure 8). It measures historical responses to 'shocks' and makes a prediction about the numbers of people employed in various circumstances.

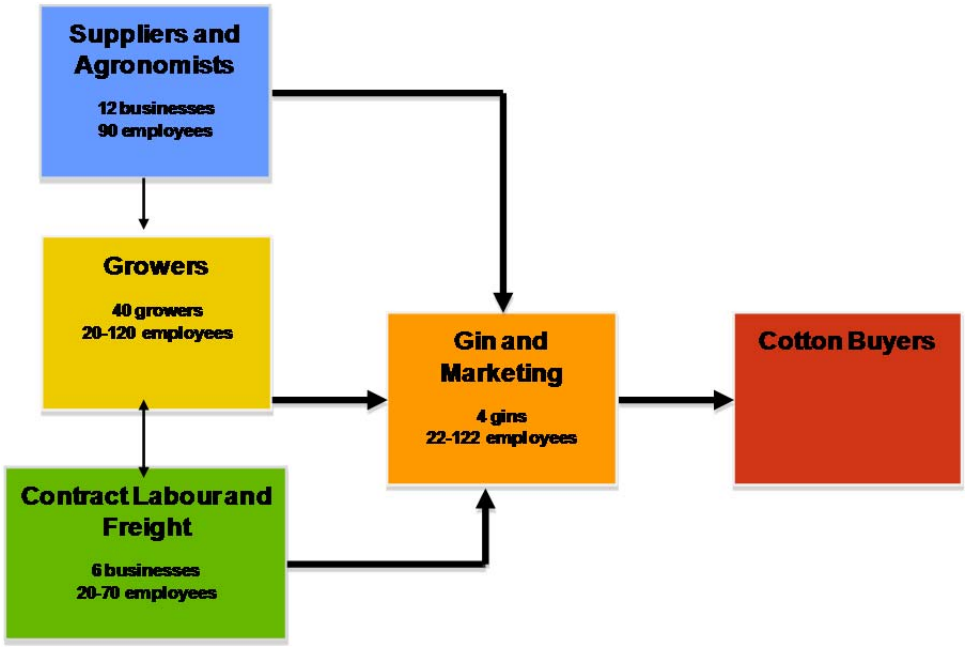

Figure 8 Economic flows and supply of jobs

The interviews also identify the key employment determinants. In the case of this community it was how much cotton was planted that determined the employment opportunities (see Figure 9). This fundamental criterion then becomes the key measure of economic activity and feeds into the overall assessment of economic vulnerability of the community.

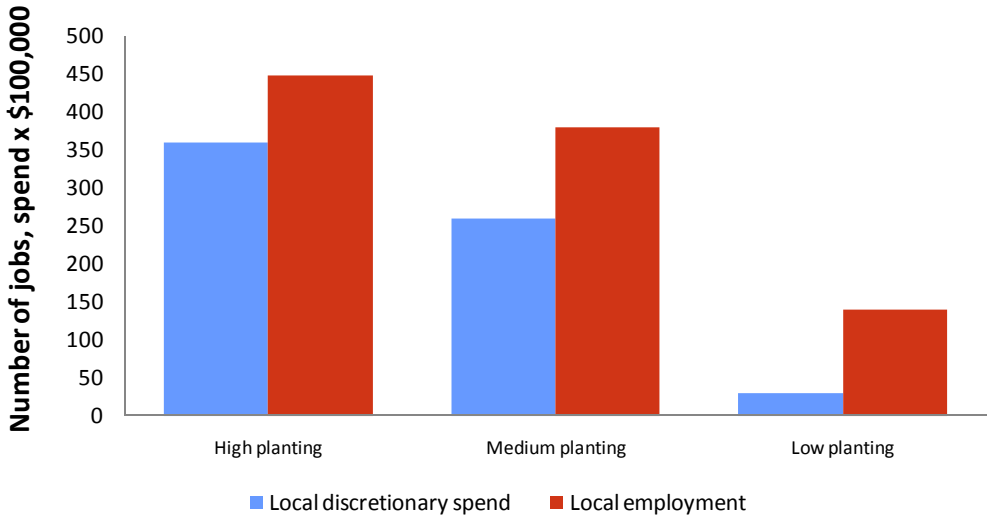

Figure 9 Key employment determinants

The understanding gained across the process results in relative assessments of the strengths and weaknesses of the community in a holistic sense (see Figure 10). It works on the community itself and its own history. It builds in how opportunities and threats have been handled in the past and delivers a series of diagnostic measures and relative position to help communities make sense of their own situation.

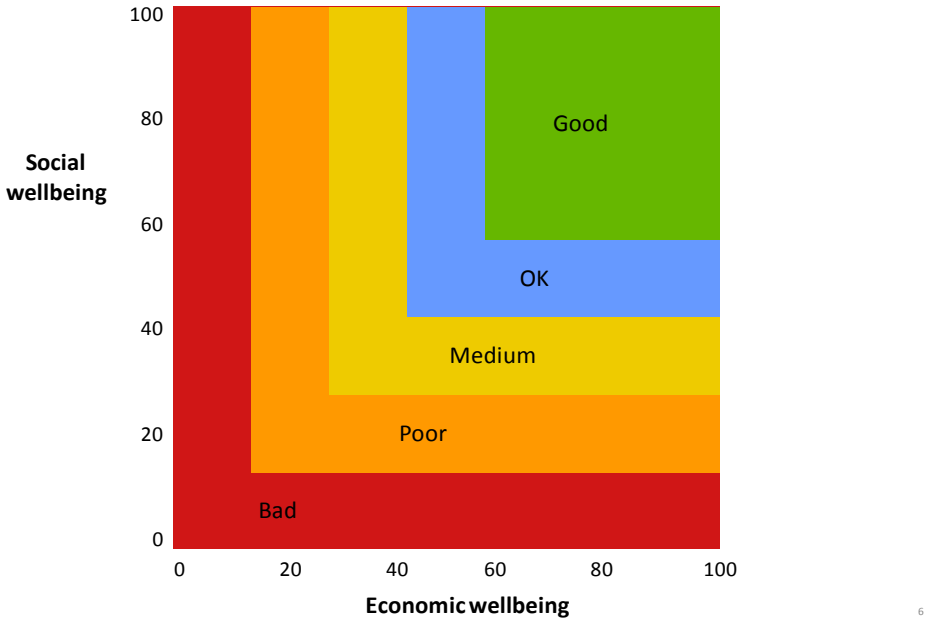

Figure 10 Assessment of strengths and weaknesses of the community

Stage 8 – Taking action

Stage 8 involves a knowledge transfer and planning session with relevant community stakeholders and the consultants.

The workshop has three main objectives:

- for the team to share the existing body of knowledge about the community, including:
  - past research
  - the research conducted for them (both primary and secondary) across all the dimension
  - a decision support system that incorporates the community choice model plus the demographic predictions
- to workshop the findings and identify those areas where action could be taken
- to train the community stakeholder in detail, specifically:
  - on the research findings and what they mean
  - the use of the DSS
  - the use of the tables or analysis.
  - evaluate the process and end products from the end-user perspective.

Outcomes of the Community Adaptability Tool

The outcomes include a process that communities can use to manage future outcomes better comprised of the following:

- a standard analysis of demographic trends and processes (an analysis plan to be provided)
- a standard economic assessment (a discussion guide and broad sampling guidelines to be provided)
- a survey tool that encapsulates the social state of the community (survey form and analysis plan provided)
- a choice modelling design proforma (to allow an experimental design to be run in standard statistical package e.g. Saw tooth)
- a demographic scenario model (code will be provided)
- reporting format.

Chapter 3 – Project engagement

Authors: Jen Cleary and Doris Carson

Rural communities in Australia have experienced increasing socio-economic challenges since the 1970s as a result of major changes, such as rural restructuring, the privatisation of previously government owned enterprises, cuts to tariffs and the introduction of GST, the deregulation of labour markets, and centralisation of government services. More recent shocks and changes have continued to affect the socio-economic wellbeing of rural communities, particularly those which have traditionally been reliant on agricultural production. These communities have been suffering from a the prolonged period of drought (1998 – 2009), fluctuating export commodity markets resulting from global commodity speculations and a strong Australian dollar, and increasing competition with the booming resources sector over skilled labour and productive land.

To continue to be socio-economically viable against this backdrop of uncertainty, rural communities require the capacity to adapt and manage change. This requires the presence of developmental values, the human ability to engage in (and take advantage of) change, and a sustainable local economic base with sufficient flow-on values and job generation capacity. Inherently, communities possess these attributes to differing degrees due to different, place-dependent development trajectories that result from different historic economic drivers, settlement patterns, and the evolution of locally specific institutions and socio-cultural values (Martin & Sunley 2010; Hassink 2010; Pike et al. 2010). Different communities may therefore develop different levels of adaptive capacity over time, even if they generally appear to be affected by the same (economic, political, and environmental) trends. What is critical in facilitating successful adaptation is that communities are able to understand the likely effects of change on their communities within their own unique and locally-specific circumstances, and how these effects might impact on their socio-economic wellbeing, be that in positive or negative ways.

One important aspect of the project *Securing the Wealth and Wellbeing of Rural Communities* was to develop an understanding of such 'local context' and how locally specific development trajectories influence adaptive capacity in rural communities. A key part of this component of the project has been the conscious attention to community engagement in the research process to develop a deeper understanding of the communities' histories and contextual factors that have shaped their present economic, demographic and other social dimensions. This paper describes the community engagement process undertaken within the project, how this processes has contributed to an understanding of local adaptive capacity, and how it has facilitated the implementation of other parts of the research project. The paper first provides the theoretical background and rationale that supports the community engagement approach undertaken. It then documents the engagement process illustrating the manner in which this supported the various project components.

Understanding Adaptive Capacity of Rural Communities

Adaptation to changing circumstances in rural areas may occur in a range of different forms. It may be proactive or reactive, and sometimes it may even take the form of an unintentional process (Adger & Vincent 2005). It may not always be directly beneficial to the community. For example, it may be a 'forced' response to a specific event, such as a community responding to the social and economic changes triggered by a population influx associated with externally driven mining activity, as has recently been the case for the Narrabri community (Fuller 2012). Some adaptations can be clearly identified as proactive, and those adaptations are often purposeful and directed, as can be seen for example in the Australian Government's Sustainable Regions Program (Dibden & Cheshire 2005) as a direct response to climate change. It is the extent to which communities are able to choose, implement and control strategies for adaptation that is critical to community wellbeing and characterises community adaptive capacity.

Various approaches to defining and measuring the ability of a community to respond to and manage changing circumstances exist. Definitions include community strength (Black & Hughes 2001), community resilience (Harris et al. 1998), community sustainability (Force & Machlis 1997; Parkins et al. 2001), and more recently community capacity (Webb & Curtis 2002; Thomson & Pepperdine 2003; Fenton 2004; Cavaye 2005; Cock et al. 2006; Mendis-Millard & Reed 2007). Despite the different definitions and etymology, several consistent themes emerge in the community capacity literature. Community capacity is associated with a commitment or community-wide will to act; the availability of financial, natural and human resources to deploy assets; and the skills to address problems and build on community strengths (Black & Hughes 2001). Community capacity can thus be said to be "the combined influence of a community's commitment, resources, and skills that can be deployed to build on community strengths and address community problems and opportunities" (Aspen Institute 1996, p. 17). This definition is useful because it recognises that community capacity has the potential to contribute to a range of outcomes (such as economic, social, political or environmental), and it distinguishes between resources and the community's capability to use them. It also recognises that a community needs to be understood as a system that consists of a range of different actors, organisations and institutions which influence the ways in which communities operate. These are important points to consider, particularly in developing an inclusive community engagement framework where local context is most critical.

Adaptive capacity is best described as a dynamic social process and is concerned with how well a community exists with, or responds to change in their circumstances. Such change may be related to social upheaval, climatic impacts, economic shocks or gradual development processes. In this context, the terms 'adaptive capacity' and 'resilience' have often been used interchangeably. While 'resilience' is a contested term with its common-sense understanding derived primarily from an engineering definition of a 'return to normalcy' (Berkes & Folke 1998), there is a growing body of work which places it firmly in other contexts, including ecology and regional development (Pendall et al. 2010). However, to date, much of this regional development work has focused on post-disaster studies of settlements and their ability to 'bounce back' following the disaster, and has not considered resilience to gradual and incremental levels of change. Such studies focus on the selection of observable characteristics or outcomes of the phenomenon, which must therefore be prefaced with questions of "…the resilience of what to what?" (Walker 2002, p. 187). There is an argument for a new understanding, or metaphor for resilience in the context of rural and regional 'resilience' (Pendall et.al 2010), and we suggest that the term 'adaptive capacity' represents this aspect of resilience, i.e. the ability of a community to adapt to change (in an evolutionary sense), and the factors which influence the development of such adaptive capacity.

Adaptive capacity is vested within the stock of local community capital that communities might be able to draw upon to meet the challenges of adaptation. Community capital can be thought of as the accumulated stock of resources that help a community determine its own development trajectory. According to Emery & Flora (2006), it consists of several interdependent forms of capital, including:

- **Natural capital:** natural assets that exist in a particular location, e.g. natural resources and amenities; geological features; weather and climatic conditions; geographic location; natural beauty (Cocklin & Dibden 2005).

- **Human Capital:** the skills, abilities, and attitudes that people have to shape their communities. Skills and abilities could include the way people are able to access external skills and expertise. It also includes people's motivations and abilities to assume leadership. Enhancing human capital through education and training is central to a flourishing economy (Flora et al. 2004). Yet, entrepreneurial attitudes and leadership capacities have also been described as being deeply embedded in the local socio-cultural fabric of communities, and may be difficult to change through education and training (Carson & Carson 2011).

- **Built or Manufactured Capital:** material and infrastructure (e.g. tools, machines, buildings, roads, railway, communication infrastructure) which contribute to the production process rather than being the output of industrial production itself (Flora et al. 2004).

- **Financial Capital:** the representative forms of financial resources available to mobilise other forms of capital, for example in the form of shares, bonds or banknotes (Lorenz 1999).

- **Social Capital:** the institutions and relationships that help maintain and develop human capital in partnership with others (for example through family ties, community relations, business networks, trade unions, schools, and voluntary organisations). It is about the 'glue' or connections between people and organisations. Two major subgroups exist. First, *bonding social capital* refers to the close ties within a community that create social cohesion and help a community pull together in times of adversity. *Bridging social capital* refers to those 'loose' social ties that link organisations and communities to important knowledge and resources external to the community (Granovetter 1985).

- **Cultural Capital:** the various cultural resources available in a community, such as traditions, heritage, language, beliefs and ideologies, which influence the formation of shared values and understanding of community identity (which in turn impacts on social capital), and also determines the 'voices' that are listened to in a particular area (Emery & Flora 2006; Lareau & Weininger 2003; Patterson 2008). Cultural capital also determines local levels of creativity arising from the diversity of cultural resources, as well as the extent of community attractiveness (Macbeth et al. 2004).

- **Political Capital:** the level of access to power and resources in order to control local decision-making, and the manner in which this occurs, for example through connections to government or other power brokers (Booth & Richard 1998; Flora et al. 2004; Lake & Huckfeldt 1998).

For those concerned with providing support to rural communities in the form of development policies and tools to assist adaptation, understanding that one-size-fits-all approaches are not effective is crucial. This is particularly important in rural and remote areas, where development policies are generally aimed at large administrative regions which are, however, often characterised by substantial internal socio-economic diversity (Carson et al. 2011). Each rural community is unique, and so the stocks of capital and the capacity to use them will differ in each community (Flora & Flora 1993; Emery & Flora 2006). This approach applies an explicit path-dependence perspective (Hassink 2010; Martin & Sunley 2010) to the understanding of community adaptive capacity. Thus, understanding why a particular community exists, how it came to be, and how it developed over time is an important part of understanding possible future development trajectories, and the capacity of the community to achieve local development aspirations. The research presented in Chapters 5 and 6 of this report build on the same approach. It analyses the demographic and economic development trajectories of the pilot case study communities to determine how past trajectories may influence future trajectories considering the communities' development aspirations. This understanding of the inter-relatedness of history, development aspirations and community capitals (Figure 11), and their collective impacts on adaptive capacity of rural communities, has been a critical part of informing the engagement processes undertaken by the project team.

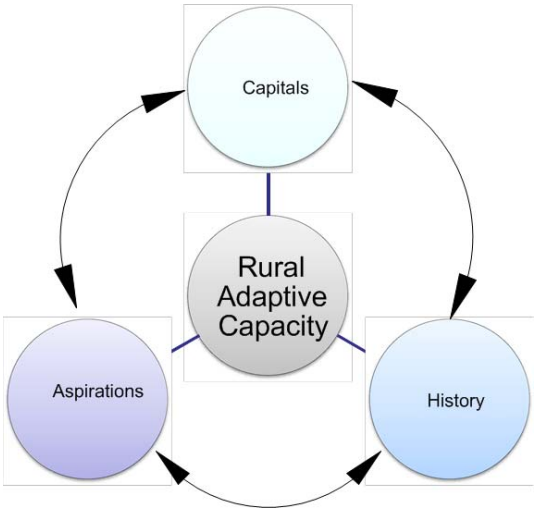

Figure 11 The interrelatedness of capitals, aspirations and history and their relationship to adaptive capacity

The Engagement Process

Establishing an Engagement Framework

Our purpose in engaging the pilot communities was to develop a deeper understanding of their current capacity to adapt to change, and to determine whether collaboratively, we could develop a tool that enables communities to understand local conditions for adaptability and determine strategies for the future. This part of the project involved multiple forms of community engagement conducted at different stages of the *Securing the Wealth and Wellbeing of Rural Communities* project, which will be described in the following sections.

The term 'community engagement' in this context refers to the degree to which a group of individuals involved in a community (who might be affiliated by proximity or interests) participate freely and by choice in an activity, such as a community project, a particular decision-making process or community consultation (Fawcett et al. 2001). As a term that has gained increasingly popularity with public agencies since the 1990s, there is a common misconception that a particular and prescriptive methodology can be applied that will enable community engagement to occur (Measham et al. 2011). This is not the case, and each series of engagement 'events', and the environments within which these occur, is unique, requiring a range of tools and processes to be employed to meet the needs of locally specific circumstances. There is, however, a set of broad 'common-sense' principles that can be used to guide and inform researchers seeking to engage effectively with communities (Minkler et al. 2008). Essentially, people will be more likely to participate in an activity if they feel connected to the activity in some way and see their involvement and the issues as relevant and worth their time investment. Additionally, participation is much more likely to be achieved if people feel there is a level of openness and transparency in the engagement process and that they have a sense of their right to have a voice in that process (Minkler et al. 2008; Rich et al. 1995). Such openness and transparency in turn relies upon the establishment of trust relationships between researchers and the community through which meaningful exchange can occur.

The project team drew upon the community model developed by Cheers et al. (2006) as a framework for ensuring comprehensive and consistent coverage of community stakeholders in each of the pilot communities. In this model, the community is represented by 11 sectors, each encompassing a sphere of human activity, such as health and human services; education and training; private sector businesses; primary industry producers; social organisation (Figure 12). Additionally, the socio-economic infrastructure of the community is represented by three 'tiers' comprising individuals,

organisations and institutions, emphasising that communities need to be considered and understood as systems. We also recognise the inherent heterogeneity of different types of communities and the pitfalls of engaging particular privileged sub-groups. To counteract this, we drew additionally on the framework developed by Harrington et al. (2008) in their work on identifying community types. Accordingly, we recognise that communities and sub-communities may take different forms, such as communities of place (e.g. residents of the towns within which we worked); communities of practice (e.g. fruit growers; farmers; retirees); communities of interest (e.g. arts groups; book clubs; sports clubs); and communities of identity (e.g. indigenous groups, disability, members of particular ethnic or religious groups). Using these combined conceptions of community, the team was able to comprehensively identify the various institutions, organisations and individuals across each sector to establish a starting point for engaging within each sub-community.

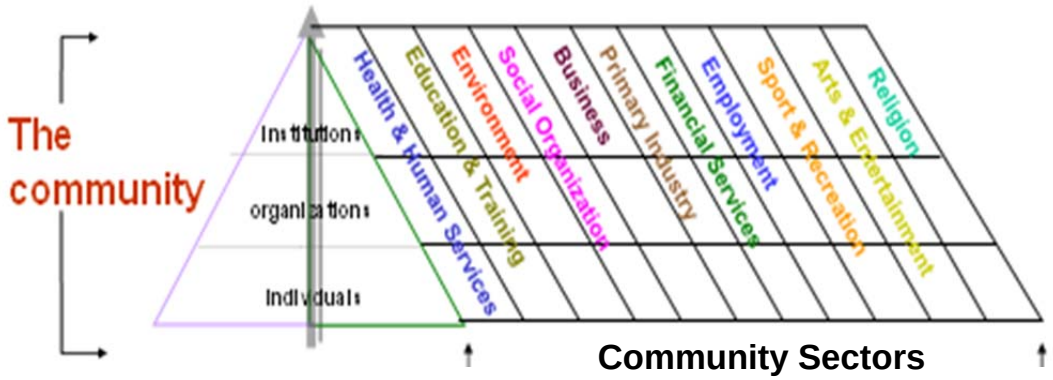

Figure 12 Community Model

Source: Cheers et al. 2006

Engagement Leadership and Prior Community-based Research

Keeping in mind the broad principles for effective community engagement outlined in the previous section, the project team determined that for each community one team member should assume a leadership role for engaging with that community, and that (where possible) this should be someone within the team who had existing positive relationships with members of the community. Where this was not possible, it would be the responsibility of the lead person to begin the engagement process by working to establish positive relationships. This was considered important in order to avoid confusion over multiple researchers and project sub-teams contacting different groups of the community at different stages of the project. The lead person coordinated the implementation of the various community consultation and data collection steps of the project, and managed the overall communication process in a way that the community could relate to a single contact person in the case of questions or concerns about the project. It was also important at this point to establish what kind of community-based research had previously occurred in the community to determine the nature and outcomes of past research (to avoid duplication of research questions and resulting research fatigue), and importantly, the general community attitude towards community-based research.

Document Archaeology and Community Conversations

In the pre-engagement phase of the project, the team began the process of understanding the specific historical context of each community, including major socio-economic trends, external shocks and development concerns. This occurred through an analysis of existing population and economic records (Chapters 4 and 5 in this report), as well as using a local document archaeology approach, which collects and examines local historic and contemporary documents, including development plans, newspapers, media transcripts, community newsletters, or minutes and other public records of local government and community organisations (such as sporting clubs, chambers of commerce, tourism associations). This process helps identify locally specific perspectives on the community's

development trajectories and provides an important contextual understanding of its development aspirations (Figure 13).

Mining boom is strangling heart of Gunnedah

- by: By Peter Lorimer
- From: The Daily Telegraph (http://www.dailytelegraph.com.au)
- March 14, 2012 7:23AM

Gunnedah Mayor Adam Marshall, right, and Real Estate agent Ben Hennessy. Picture: Peter Lorimer
Source: The Daily Telegraph

WITH instant wealth, often comes unexpected hardship.

It's that brutal lesson the once-blithe township of Gunnedah, in north-western New South Wales, is now attempting to swallow.

The true heart of the town is dying on the inside; a victim of its own success and the mining dollars that have flooded into its streets, transforming it into one of the most expensive places to live in the nation.

Figure 13 Example of document archaeology in Gunnedah

At this point in the project, detailed demographic profiles were also prepared for each community using current and historical census data (see Chapter 5 in this report). These demographic profiles were customised for each community and summarised in the form of a colourful and engaging poster, documenting socio-economic trends in the community (Figure 14). The posters were subsequently used during the engagement process as 'conversation starters' in the pilot case study communities. In the case of Waikerie, for example, members of the project team attended a community event during March 2012 and set up an information stall at which the poster was featured (Figure 15). Because the poster was easy to understand, and the information contextualised and specific to the Waikerie community, it was of high interest to local community people, and many of them subsequently agreed to participate in more detailed interviews and discussions with the researchers. Feedback from some community members suggested that the posters were very useful in establishing trust between the research team and the community, because they demonstrated that the research team was not only seeking to extract information and input from the community (in a one-way direction), but it was prepared to share expert knowledge with the locals and feed the various research outcomes back to the community.

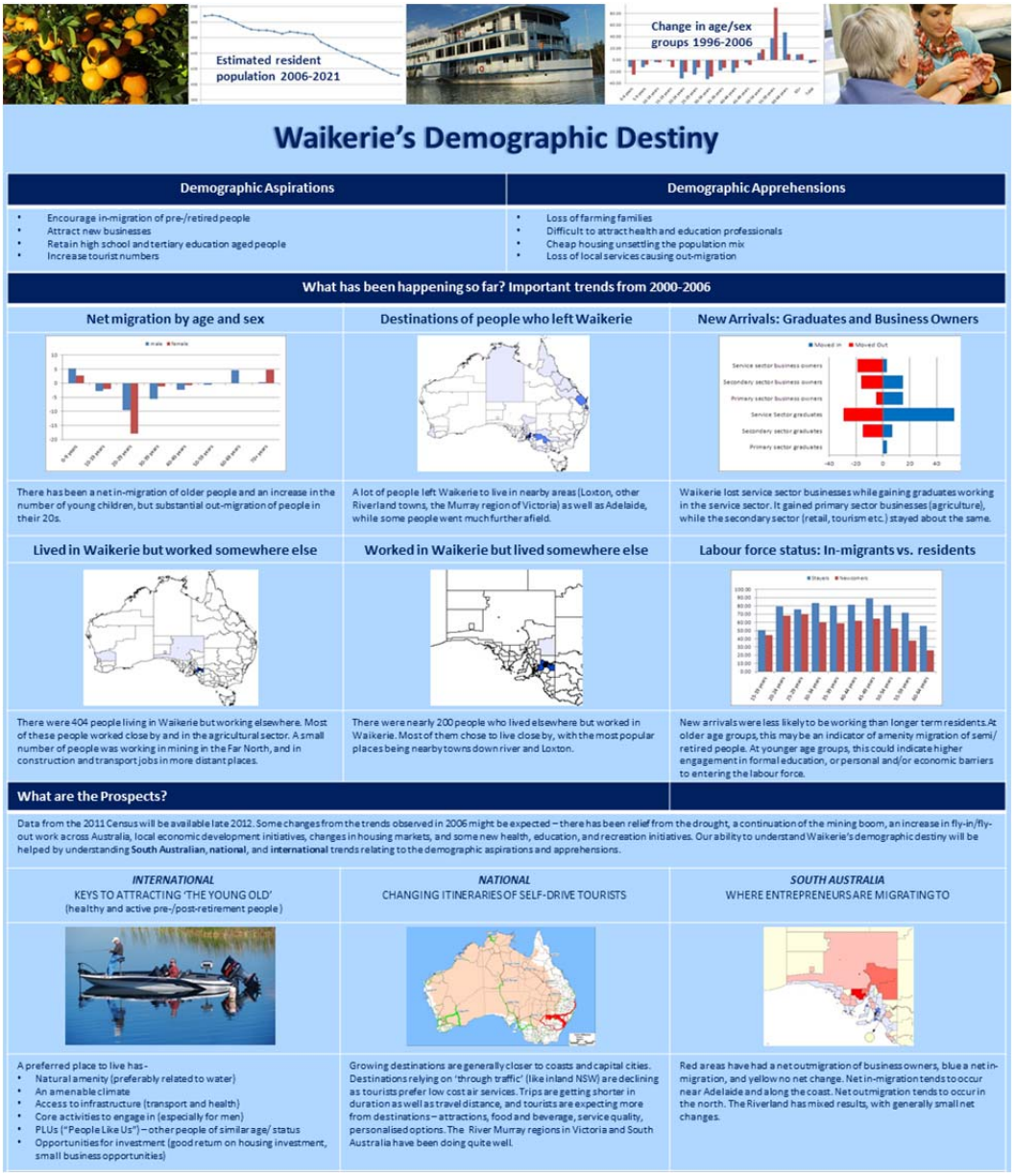

Figure 14 Demographic profile poster, Waikerie

Figure 15 Researchers discussing project poster with community members at the Waikerie Riverfront Redevelopment Opening (22-25 March 2012)

The posters became an important part of the pre-engagement process, especially in generating interest in the research. For example, when media advertising about the project occurred, many people were already aware of the project and were thus alert to receiving further information. In addition to using the posters at community events, members of the project team visited the communities on multiple occasions and spent several days meeting with a range of community leaders in formal and informal settings. For example, formal meetings with local government representatives and leaders of various social community groups were held in Waikerie and Gunnedah during which the project was discussed and support established. In addition, informal conversations with community members were held in local pubs, art galleries, shops, and visitor information centres to introduce and discuss the project. All of these activities (which came to be labelled by the project team as 'street talking') increased the project team's contextual understanding of the communities and contributed to the process of engaging with community members. They also enabled the team to identify potential local project 'champions' who would promote the benefits of participating in the project to other community members and encourage a favourable presentation of the project in local media outlets (Figure 16). The team found this to be a valuable part of the engagement process. For example, when community surveying was being undertaken (see Chapter 6) the team found much greater responsiveness as a result of the engagement that had already created a high degree of awareness of, and interest in, the project.

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Research spotlight on Waikerie

Waikerie will have a rare glimpse into its future needs when a major demographic and economic research project is complete.

The study team involves social researchers from Flinders University, the University of South Australia, the University of Canberra, and the Australian National University as well as expert consultants.

The project seeks to develop a decision support tool, which communities can use to assess the likely impacts of future change on the demographic and socio-economic basis of their community.

Following on from a conference in the Waikerie Council Chambers earlier this month, researchers will be contacting 500 local residents for their input.

"This is a really important project, so we are wanting everyone to say 'yes' to take part," said District Council of Loxton Waikerie community services director Ruth Firstbrook.

"They are also looking for 15 people they are terming as 'knowledge banks'. So if you think you are a knowledge bank of Waikerie, identify yourself to the researcher.

Figure 16 Media engagement in Waikerie

Aspirations and Apprehensions

Finding out what people were concerned about was an important part of understanding the 'community stories' for each of the pilot communities. The community's development aspirations and apprehensions (Figure 17) were discussed in community seminars, which were organised at the start of the project, and more formally through in-depth interviews with volunteering community members. Community members were queried on topics such as what they thought mattered most for the future, and how they imagined the future to be. They were also asked what they thought would be required to achieve their preferred future (in terms of skills, capabilities, financial resources, leadership). In-depth interviewing queried community members about historical perspectives (e.g. their perceptions of how/if the population had changed over the last 10-15 years; what they thought were the most important events and trends that had changed their community) in order to identify collectivised

perceptions of history and any variance between interviewees and other data sources. In-depth interviewing also revealed perceptions about the local economy (e.g. people were asked what they thought mattered most in terms of the local economy) to determine whether perceived specific economic activities aligned with ABS and other data. Interviews sometime revealed very interesting variances between community perceptions and official data sources. For example in the case of Waikerie, the local Cadell Training Centre accounted for 64 jobs in the area (hence, a substantial generator of local jobs), yet it was not mentioned by any interview participants as being important to the local economy. This indicates that it was not perceived to be representative of the traditional forms of economic activity (irrigated horticulture and manufacturing linked to fruit production) that have been the mainstay of the local economy, indicating some degree of 'lock-in' (Martin & Sunley 2010) and a lack of recognition of alternative economic development paths. People were also queried as to how well they thought their community was faring compared to other rural communities; how welcoming they thought they were to newcomers and how well they were able to connect with other communities and external stakeholders to access important resources.

Aspirations	Apprehensions
• Retain young people in town and attract families with children to slow down population ageing • Attract university graduates back to town • Attract skilled workers (especially in the trades and health sectors) • Increase attractiveness for lifestyle retirement • Harness multiculturalism to attract visitors and migrant communities	• Impact of mining on local housing and employment • Increase in non-resident workforce • Outmigration of young people leading to acceleration of population ageing • Declining number of community volunteers • Difficult to attract and retain professionals in key service sectors (health, education, police)

Figure 17 Summary table of Aspirations and Apprehensions in Gunnedah Community

Analysing Community Capitals

Extensive and comprehensive community surveying was undertaken as a key part of the project (see Chapter 6). This component of the project addressed aspects of community health and wellbeing; live-ability and satisfaction. In-depth interviews conducted during the engagement phase of the project added to the data collected through surveys. Insights from the interviews were used to contextualise survey outcomes and more deeply inform what people thought about their community's capacity to sustain themselves into the future. The in-depth interview data were analysed against the seven community capitals (Emery & Flora 2006) and then triangulated against the survey and the demographic and economic analysis data of the project. Again, some interesting correlations and variances were found. For example, survey data suggested in one community that innovation and entrepreneurship were not highly evident. In-depth interviewing revealed similar findings, but was able to additionally identify that this was partially the result of high levels of strong bonding social capital and a lack of bridging social capital in that community (Carson & Cleary 2012). Interview data suggested that strong bonding social capital had arisen as a result of relationships and shared values built up over time around single-focus economic activity in the community. Under this scenario, entrepreneurship and innovation had not been needed historically, and the community had developed accordingly along this single-focus economic trajectory, creating a situation of economic 'lock-in' (Martin & Sunley 2010; Hassink 2010). Interviews revealed a high level of community pride in existing social infrastructure such as service and sporting clubs and cultural heritage in this community, and subsequently there was a strong culture of 'survival' and 'maintaining the status quo', rather than an entrepreneurial culture seeking to implement new strategies.

Supported Decision-Making

Informed decision-making relies on the availability of high quality information. Providing that information back to the participating communities has been a critical component of this project, and the ultimate goal of the project will be to 'train' local communities in using the decision-support tool developed for this project (see Chapter 6) to inform their own local decision-making. An important point here is that the cyclic process of 'research-in-action' with frequent feedback loops, opportunities for reflection, and intense engagement with the community has been a necessary part of achieving the depth of analysis, and thus the highly localised information which has been made available to communities at each step within the process (and to which the communities themselves have been integral contributors). The cyclic process in itself is a form of capacity building. Raymond & Cleary (2013) similarly found this to be the case in their work with natural resource management (NRM) communities in the South Australian Arid Lands. New knowledge is generated within the community through the process of social learning which is then applied through an interactive process of problem solving (Fazey et al. 2010). This has been exemplified in the Waikerie community for example, where members of the community have participated in several feedback seminars, and have shaped and re-informed the subsequent stages of the research process (Figure 18).

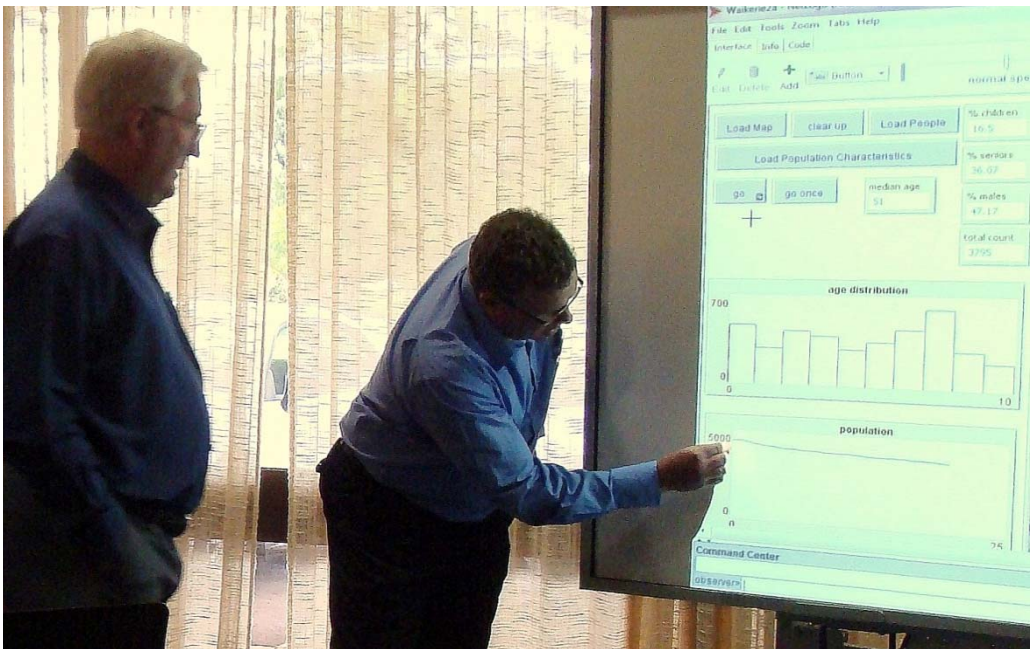

Figure 18 Team member explaining project outcomes to a community member in Waikerie

As a result of scenario development and the application of locally relevant knowledge and information, the community has been able to reflect upon the information and has subsequently sought further, more specific information about particular development options. For example in the case of Waikerie, the local community development officer invited the research team back to give a specific seminar about the prospects of tourism in Waikerie (Figure 19). The research team in turn has been able to facilitate knowledge exchanges between community members and knowledge holders outside the community. The level of engagement that the project has generated has enabled and facilitated these knowledge brokering partnerships. For example, the follow-up seminar on tourism in Waikerie brought together a range of stakeholders from all over the Riverland, including tourism business owners, members of different chambers of commerce and visitor information centres, as well as the regional destination manager, to engage in discussions and exchange ideas. According to local government members, this process of interaction at a regional level would have not occurred without the brokering role of the project team. It is interesting to note that there is an element of 'trusted outsider' (Moran 2008) in the role undertaken by various members of the research team at this point in the process. Moran described this role in small, isolated and remote Aboriginal communities in the Northern Territory as one of facilitating knowledge exchanges inter-culturally, between Aboriginal

community members and (largely) non-Aboriginal, exogenous service providers. We postulate that a similar situation has been occurring within this project, in that knowledge exchanges have been facilitated across an 'insider' (members of the community) and 'outsider' (knowledge holders external to the community) cultures. What is common to both situations is the high degree of trust that acts as an enabler. Such trust in this case has been built upon deep community engagement.

Figure 19 Follow-up tourism seminar in Waikerie, 12 February 2013

Summary

This project highlights that there is no 'one-size-fits-all' prescriptive process that enables engagement to occur, and that a variety of tools and mechanisms that are fit for specific purposes and local conditions must be considered. However, we support the view that recognising and embracing a set of guiding principles is an effective starting point. What matters most is that the engagement strategy meets the needs of local stakeholders and communicates outcomes back to the community as an ongoing process, which may (and should) continue beyond the immediate phase of data collection. For this project, deep engagement embedded in social processes and trust relationships has been integral to the achievements of the project to date. This has entailed a long-term commitment to the communities that the project team has been working with, and the recognition that determining clear and consistent engagement leadership at the commencement of the project has been a critical success factor. We also recognise that engagement has been mutual, in that community members have been integral to the development of the research process and outputs, and that the process has not been extractive but contributed substantially to building community capacity. Finally, we want to emphasise and acknowledge that successful engagement is not measured by those seeking to engage, but by those with whom one is seeking to engage.

Chapter 4 - Economic profiles, supply chains and modelling future scenarios for the three case study communities

Author: Kim Houghton and Thomas Fell

Background

This research project is one component of a larger inter-disciplinary project on *Securing wealth and wellbeing of rural communities*. This component addresses economic adaptation in regional economies. This economic component sought to develop a dynamic, localised model of regional economies with three important characteristics:

1. built on local specialisations (rather than assuming them away)
2. enabling realistic assessment of adaptive capacity under different scenarios
3. able to link commercial flows with community and environmental characteristics.

This report presents the findings on the socio-economic profiles and histories of the three case study regions (St George, Gunnedah and Waikerie), then summarises the main local rural supply chains in each region as drawn from interviews and data analysis, and then presents and discusses the results of the model building and modelling.

The economic research sought to assess the accuracy of a statement repeated through the community profiles in the draft Basin Plan:

> 'The relationship between water availability and economic activity is more or less a straight line.' (Murray-Darling Basin Authority 2011, p940)

Assessment of this assertion was thought to be required as through the early 2000s, and in particular through the drought years, while water availability and production were highly variable, the flow-on effects through regional economies appeared very mixed. Despite the concerns raised at the height of the drought, and despite the genuine economic hardship clearly experienced by businesses in regional communities, no towns appear to have 'died' as a result of reduced water availability. Better understanding of the links between these economic relationships will help communities identify their economic 'tipping points' and adaptive capacity.

This project sought to identify and quantify the nature of the relationships along the rural supply chains, to better understand the linear and non-linear relationships between production and local economies.

Socio-economic profiles

St George

Some 26% of the population of St George is employed in agricultural industries, compared to 41% in Balonne shire as a whole. Of the 400 people employed in agricultural industries in St George, about half are farm managers, and there is relatively little flow-on to labouring (1 labourer for every two managers) and 'service to agriculture' which includes activities such as fertilizer spreading, harvesting, agistment and veterinary services . Businesses are predominantly small, but show signs of diversifying in response to drought

St George and its surrounding region are now highly dependent on irrigated agriculture both directly and indirectly as a major source of economic activity and employment; crops account for approximately 60% of the total value of agricultural production. Employment intensity in irrigated agriculture is significantly higher than dryland farming, and irrigated farming has allowed the St George community to thrive and grow. However, a regional economy focused in this way is vulnerable to changes in external circumstances, and the heavy reliance of the Shire's economy on irrigated cotton means that variability of production, for example in recent drought years, have significant flow-on impacts in terms of population, employment and income.

Gunnedah

Similar to St George, cotton provides significant income for the economy of Gunnedah. However, interviews with farmers and community members showed that there is much greater variability in crops grown in the area and interviews with farmers showed that the affects of drought in Gunnedah have been more localised (i.e. felt differently at the individual farm level). Water security for many farmers is high in Gunnedah, due to access to groundwater. Most businesses in Gunnedah were less affected by drought and appear confident in the future of the town, though cotton gins are directly affected by cotton production and variations in their needs from season to season can have significant impacts on employment in the supply chain.

Waikerie

Interviews with growers and community members in Waikerie revealed the hardship of the last decade for both the citrus and grape growers. Both supply chains have had to make significant adaptations to cope with declining terms of trade for growers, including reducing casual and part-time staff. As in other areas, processors and businesses dealing directly with produce were likely to be heavily affected by reduced production, whereas agronomy and general agricultural suppliers were usually more diversified and resilient.

Unlike "cash crop" areas such as St George and Gunnedah, planting fruit trees or vines requires significant long-term investment and planning, and there is less scope for changing crops to suit different environmental conditions. Waikerie also has far less opportunity for improving irrigation efficiency, as it already has highly developed irrigation infrastructure. Uncertainty over water regulation has been a compounding factor in creating difficult conditions for growers.

Supply chains

Interviews with farmers and farm-servicing businesses in the three case study areas provided details on the supply chains in each area. In St George and Gunnedah the research was focused on the cotton supply chain, and in Waikerie it was focused on citrus and grapes. The methodology can be applied to other crop-specific supply chains where the base data can be gathered.

The flow along the supply chain in each area is based on the following links:

- area planted determines local spend and local employment
- quantity of harvest determines ginning/processing activity levels and employment
- value of harvest determines debt repayment, capital investment and discretionary spending in the community
- harvest value is offset by water availability and cost influences on aggregate operating costs, and therefore profitability.

There are three critical points along the supply chain:

- in the cotton communities one of the most critical drivers is the grower planting decision and the decision rules that drive it as it is this decision that has the greatest immediate flow-on effect into the local economies. In Waikerie, the crucial decision is whether or not to keep an orchard or vineyard in production, and how much (more) to invest in water efficiency technology.

- maintenance of local processing and value-adding capacity which not only services the growers' needs but also has significant local employment flow-on effects. With widely varying production levels it is clear that some value-adders and processors are still reviewing their viability. And while in the wider context the loss of such a facility will mean more business for a neighbouring region, the local flow-on effect from less employment could be important.

- nature and extent of the local 'farm business infrastructure' like rural supplies, contractors, aerial services or transport which determines local value-adding. Wide variations in planting/production levels have placed pressure on the long-term viability of some of these businesses. While growers would source their products/services from elsewhere, the loss of local jobs in any of these fields would have further negative impact on the local economy.

Changes over time

Is the past a good guide to the future? Past experience shows the real changes that have been brought to the production system, but there is always the possibility that future external challenges will be handled differently. The interviews showed that farmers and businesses in the supply chain have made (and are likely to make in future) few changes to their operations until water availability and/or production levels fall by over 25%. From 25% to 50% reductions activities and labour will be scaled back. And for reductions above 50% more significant adaptations will be made.

Employers tend not to let full-time staff go, and community members tend to defer leaving the area for as long as possible. The attachment to place held by both residents and workers serves to internalise the impact of bad seasons – slowing the pace of real adaptation by making movement 'sticky', and also slowing the pace of recovery as financial debts and low levels of capital investment take several good seasons to recover from.

Over the 2000 to 2011 period there have been 4-fold to 6-fold year-to-year peak to trough variances in agricultural production, so growers and businesses have had to put these adaptation strategies into practice on many occasions. Grower adaptation experiences tended to focus on

- maintaining 'permanent' staff (eg rotation through other sites where available and busy)

- deferring non-essential purchases

- planting wherever possible.

> "The biggest impact on the bottom line is cotton production . . . your first and foremost focus is to have production." (Cotton Famer St George)

> "In a dry year we don't replace any machinery at all." (Cotton Famer St George)

A reduction of water availability of 10% or 20% is well within normal business parameters and growers will use immediately available tools to vary the mix of farm operations and scale of planting to minimise any negative impacts on their farm businesses by reducing costs and widening income streams where possible. Adaptive measures taken were:

- increase borrowings

- sell business assets

- seek other business income

- reduce labour (and defer non-essential spending)
- decrease plantings
- change crop mix – minimal area of cotton, with balance to crops requiring less water.

Further reductions in water availability, though, have much deeper effects on operations. A 50% reduction in water availability means that growers will review the viability of the farm in that season and will consider selling assets, finding other income or employment, leaving farming and leaving the community.

Business owners (non-farm businesses) reported that they take action if activity levels drop by over 25%, but that the main actions involve monitoring and reducing costs by, for example:

- scaling back purchasing
- scaling back casual staff but maintaining 'permanent' staff.

As with growers, though, if activity levels drop by 50% then more drastic action follows such as active diversification into other business income, overall reductions in staff and contractors, and reduced spending on other operating costs. Only those businesses directly handling farm products react faster – with citrus processors saying they will start to lay off casual staff with a 10% fall in activity, and cotton gins adjusting their casual employment levels to suit the scale of flow of cotton bales.

Modelling local economic adaptation

The modelling process used here is based on a local production systems approach which draws on data collected from local growers, crop handlers and value-adders on their scale of operations (including employment), the factors that determine this, and the main upstream and downstream links in the supply chain. This approach was selected as it gives a much more accurate picture of the scale of activities along the local agricultural supply chain, and their responses to increased or decreased activity. This is a key weakness on the more common 'top down' input-output or general equilibrium modelling approaches.

The local production systems model puts boundaries on upper and lower activity levels and on employment and turnover levels based on external limits like water availability. The model is designed for predicting responses to changes in these external limits rather than predicting crop yields (the latter is a different science).

Three scenarios were modelled:

- high level of planting and of water availability
- medium level of planting and water availability
- low level of planting and water availability.

The model showed that for the two cotton communities on-farm employment is likely to vary by a factor of 4 between the low planting and high planting scenarios. Flow-on employment would vary in range of 2-fold to 5-fold.

For St George, it is likely that the total on-farm and immediate flow-on employment would vary by a very significant 307 employees between the best scenario (445 people) and the worst (138 people). These projections take account of the changed employment response for the high/medium and worst scenarios, and amounts to some 14% of the Balonne Shire workforce in 2006. For Gunnedah, the variance would be 390, between the best scenario (633 people) and the worst scenario (243 people).

This is a smaller proportion (8%) of the larger Gunnedah workforce. The higher water and labour costs anticipated from the worst case have also been factored in, leading to 10-12-fold differences in the amount of discretionary spend from growers into the community.

The modelling for Waikerie shows that the direct and flow-on levels of employment vary from 440 in the best scenario, to 210 for the worst scenario. This is a change of 230 people, some 32% of the jobs in Waikerie. The Waikerie modelling shows a nearly 3-fold variance in grower discretionary spend between the best and worst scenarios, indicating significant flow-on impact across the local economy.

Conclusions

It is clear that in modelling local economic activity in these rural study areas, the main players in the supply chains are experienced in handling variability in agricultural activity levels, and that there is not a simple, linear relationship between planting, harvest and local flow-on spending. In particular, it is not accurate to predict flow-on spending by growers, or employment levels on farms or processing businesses, as a fixed proportion of areas under crop across a wide range of cropping areas. There is a tipping point for grower and business adaptation between 25% and 50% reductions in water availability, with practices for both groups changing significantly across this boundary.

It is important to understand the nature of these tipping points and improve understanding of the impacts of changes on agricultural production, so that communities have access to more robust and more intuitively believable modelling. Earlier simplifications which base modelling on fixed relationships like employment per megalitre of water used have had little traction in communities. The interviews, local histories and modelling done for this project have shown that this is clearly not the case, and that to base further research on such an erroneous assertion is to invite community criticism.

While some level of variation is expected as 'the norm', the scale of the downstream consequences is significant. The best/worst scenarios showed an 8% impact on total employment in Gunnedah, 14% in St George and 32% in Waikerie. The modelling also showed that a 5-fold increase in area planted (or of water available) could lead to a 10-12-fold increase in discretionary spending in these regional economies – a very significant 'topping up of the economic tank'.

This project has been about testing proof of concepts in an alternative approach to understanding the linkages in small agricultural economies. It has tested a bottom-up approach built around intelligence about the flows within the local economies, and how these have adapted to external changes over the last decade or so. This approach seems useful in being able to generate believable scenarios for local futures, but will require more fine tuning before it is methodologically robust.

Balonne Shire and St George

Introduction and History

St George is the principle township of the Balonne Shire. The Shire of Balonne is located in Queensland on the New South Wales border some 500 kilometres (km) from the east coast of Australia and has an area of approximately 31,000 km^2. St George was founded in around 1850 as the district centre of what was then mainly a wheat-sheep area. This was true until the mid-twentieth century, when the community began a transition towards irrigation production, mainly of cotton. The Balonne regional economy has always been highly reliant on agriculture, with 2006 Census data indicating that 36.1% of employment was in agriculture, or 10.6 times the ratio for the whole of Queensland. The value of agricultural production for Balonne Shire in 2005–06 was $221 million, of which $134.1 million was crops of mainly cotton (Murray-Darling Basin Authority 2010).

While the population of the St George has always been relatively small, it has seen two major fluctuations associated with the fortunes of its primary producers: an increase beginning in the late 1940's due to irrigation development and diversification, and a recent decline associated with drought

and water availability. St George's population has always been tied to agricultural producers in the wider shire, particularly in the last ten years with the affect of prolonged drought (see Figure 20).

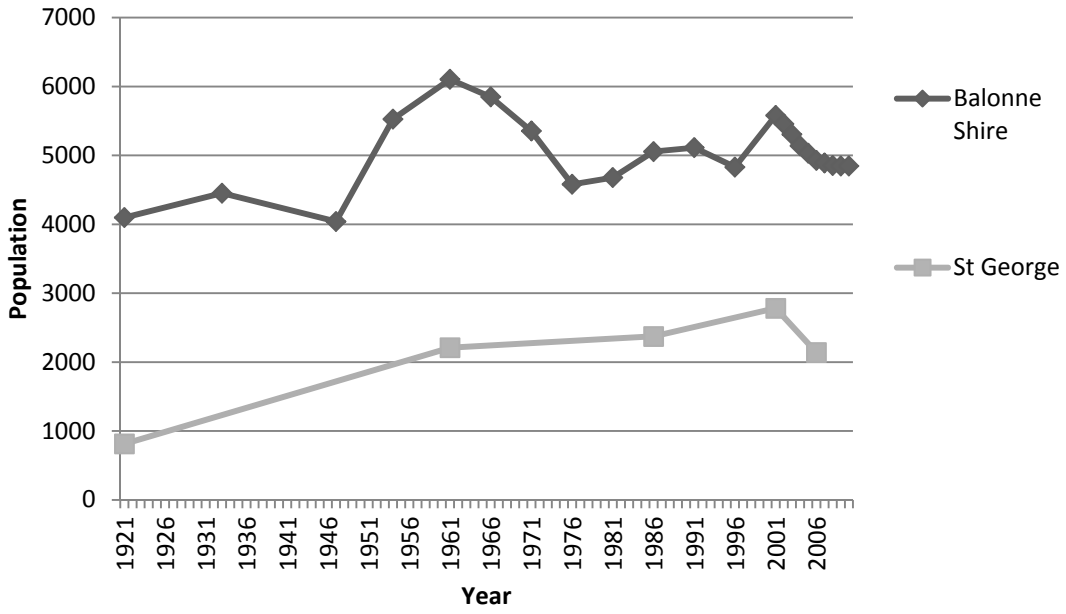

Figure 20 St George and Balonne Shire population

Source: ABS 2006

There was strong private and public investment in irrigation infrastructure in Balonne Shire during the 1950's and 1960's, helped by government enthusiasm for development and money from the boom in wool prices. The construction of weirs and holding tanks improved grazing, by tempering the erratic flows of the Balonne River, and allowed diversification into irrigation cropping. The St George Irrigation Area was established in the mid 1950's based on supply from Jack Taylor Weir on the Balonne River and the construction of the original St George supply channel. The system was extended in the following decades, with completion of the Beardmore Dam and the Buckinbah supply channel. This expansion increased economic activity in St George, which developed much more than the surrounding towns that were more reliant on grazing. There was a 30% increase in population during 1954-66, which led to significant investment in the town. The expanding economy of St George also created a housing squeeze in the 1970's; to fulfil demand houses were transported from the surrounding grazing regions, which were experiencing a decline in population (Lucas 2004).

The irrigation infrastructure in Balonne eventually led to cotton becoming the predominant crop in the area, and the first Queensland cotton gin was built in St George in the early 1970's. The late 1990's saw the addition of the Dirranbandi cotton gin and a second cotton gin in St George. At the present time the St George Irrigation Area covers approximately 19,000 hectares (ha).

In the five years from 2001 to 2006, Balonne Shire lost almost 15% of its population. St George lost approximately 600 people (22%) in the same period. This contrasts with the Murray-Darling Basin (1.1% growth in the same period) and 10% cent growth in Australia as a whole (Stubbs 2010). Drought was a major factor in the decline; average volume of water used in the Lower Balonne for the period 1995–96 to 2006–07 was 226,986 mega litres (ML) per year, but the actual use has been much lower for most years after 2000 (Murray-Darling Basin Authority 2010). Due to drought conditions, and the resultant fluctuations in the cotton crop, recent years have seen a limited diversification of irrigated agriculture into crops such as grapes and more dryland cropping.

Agricultural Production

In 2006, there were 2,485,443ha of land under agricultural cultivation in Balonne Shire, and approximately 50 cotton growers in the area around St George and Dirranbandi. The majority of this land was used for grazing, with a small proportion used for broadacre crops and with cotton a smaller but economically significant use; the value of agricultural production for Balonne Shire in 2005–06 was $221 million, of which $134.1 million was crops of mainly cotton (Murray-Darling Basin Authority 2010).

The MDBA's regional profile for the Lower Balonne (Marsden Jacob Associates et al. 2010a) noted that the St George Irrigation Area covers approximately 19,000 ha, with most of that (12,000 ha) set up for irrigation. Cotton is the dominant broadacre irrigation crop (although some irrigated sorghum, wheat and barley is produced), while smaller areas are under irrigated horticulture (grapes, melons and some vegetables, particularly pumpkins, sunflowers and onions). In 2005–06, approximately 8,700 ha were under cotton, 800 ha under grapes and 200 ha under vegetables. The area planted under cotton has varied considerably in recent years, from under 1,000ha to over 50,000ha, and averaged around 35,000 ha before 2001.

With a reasonable harvest cotton is the largest contributor to agricultural production by value, followed by beef cattle and cereals (see Figure 21).

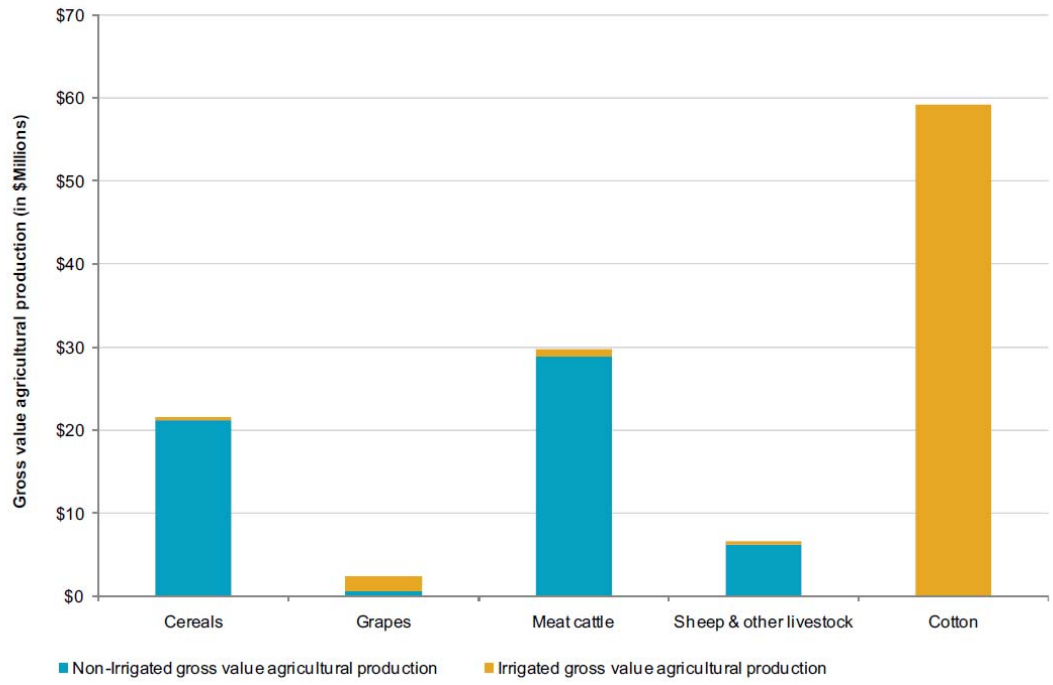

Figure 21 Gross value of agricultural production 2006

Source: Murray-Darling Basin Authority 2010, p885

Cotton Production

Cotton plantings and yields can vary significantly from year to year, depending on factors such as water availability, temperature and insect pressure. Figure 22 below shows area planted in the cotton growing regions of Queensland between 2000 and 2009. In St George the area fluctuated between over 20,000ha and under 10,000ha, while Dirranbandi experienced a year of no plantings in the last five years due to drought conditions. Between 2000 and 2008, the number of cotton bales ginned in the St George cotton growing region has varied from 26,000 to 185,000 with an average of 114,687 bales per season (Roth 2010).

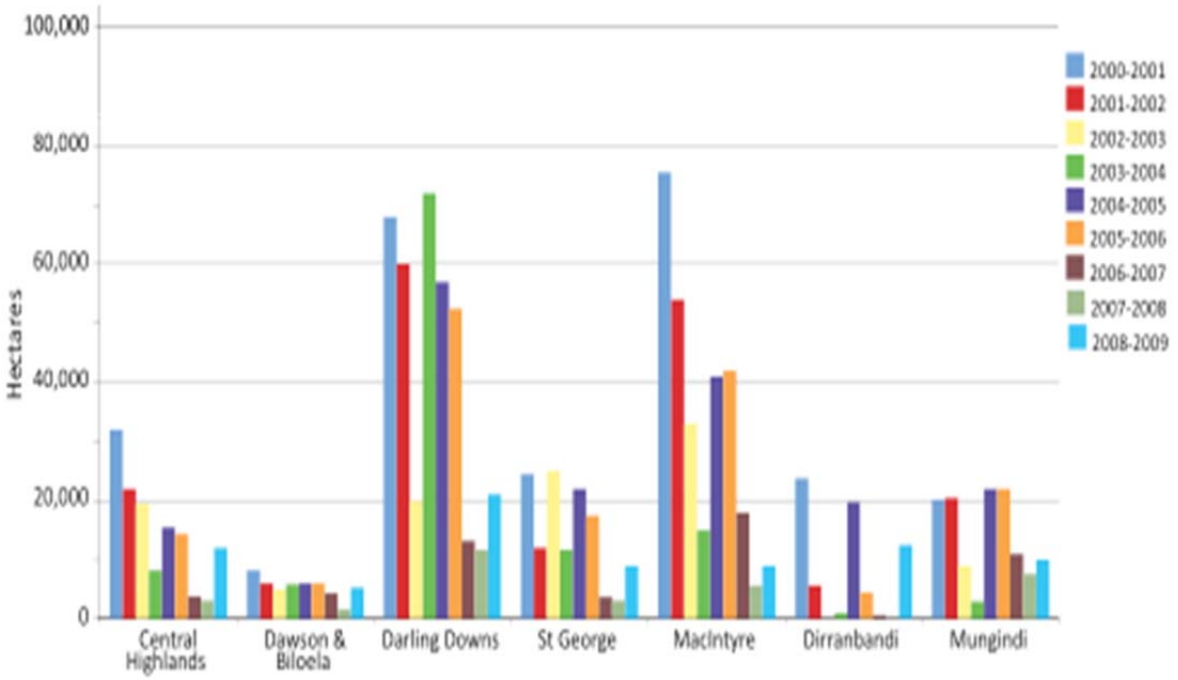

Figure 22 Area of cotton in Queensland

Source: Roth 2010

Employment

In 2006, there were 2,058 people employed in Balonne Statistical Local Area (SLA). Of these, 844 people (41%) were employed in agriculture, fisheries or forestry. The majority of these were in grazing (462 people, 55%). Lesser but relatively high proportions were represented by cotton (179 people, 21%), as well as the balance of other agricultural services (102 people, 12%) and cereals, oilseeds and other broadacre land uses (68 people, 8%). The retail, education and health industries were the next biggest employment industries (11%, 8% and 8% respectively).

Figure 23 and Figure 24 show overall employment by industry in St George and employment by occupation within the agricultural sector, respectively. In St George in 2006 there were 316 people employed in agriculture, and 63 employed in 'Agriculture, Fishery and Forestry Support Services' (out of a total 1543 employed persons in the town). Similar to the shire as a whole, retail trade and health industries were the next biggest employers. Of those 401 people in St George working in agriculture, fishery and forestry, 163 were machinery operators, labourers, technicians or trades people, while 129 were managers, administrative workers or professionals.

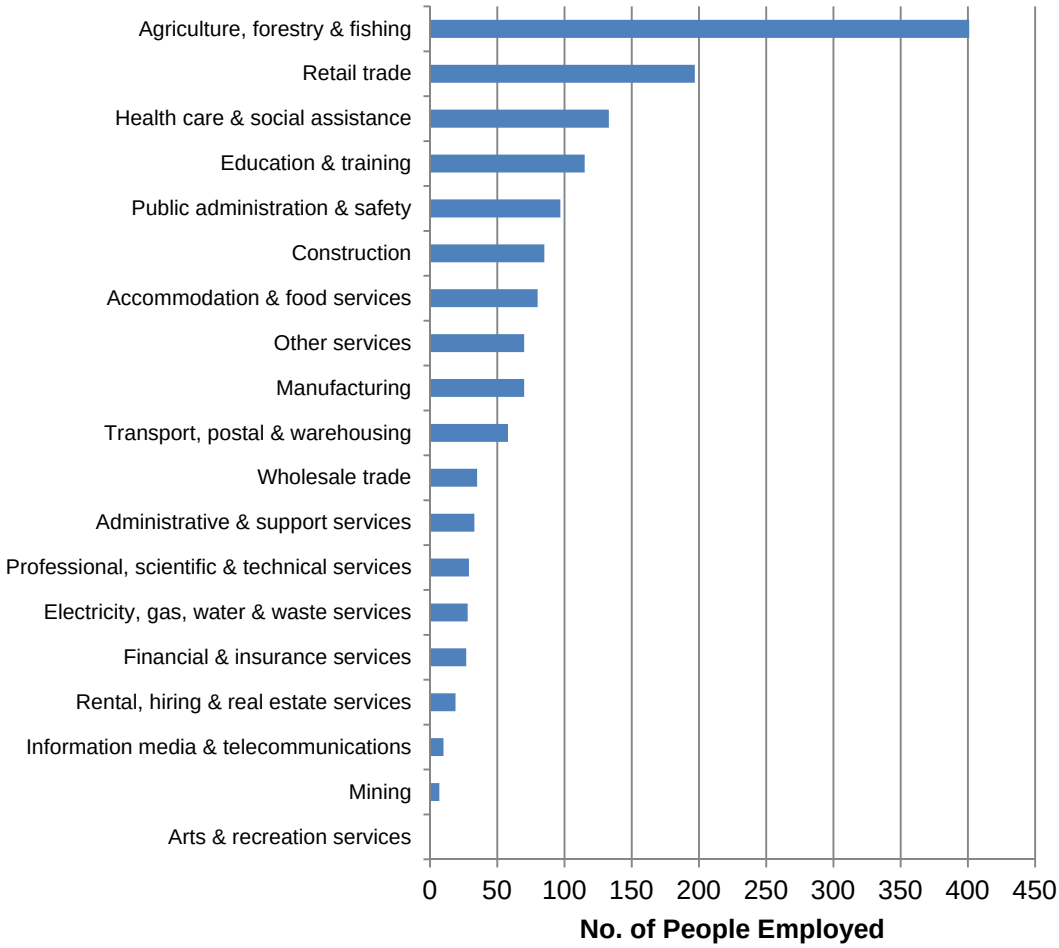

Figure 23 Employment by industry, St George

Source: Australian Bureau of Statistics 2006

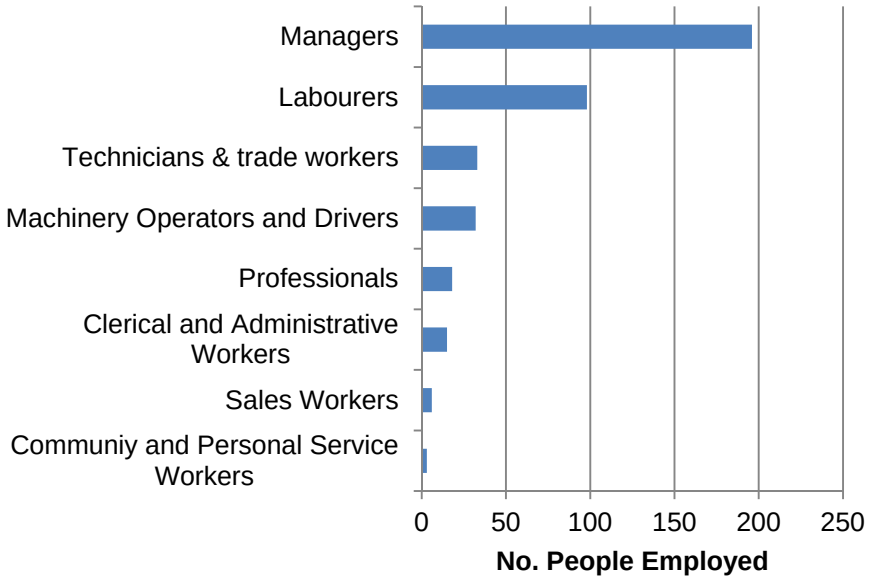

Figure 24 Employment by occupation in the agriculture sector

Source: Australian Bureau of Statistics 2006

Business

Figure 25 shows the number of businesses in Balonne Shire in 2009. Of a total 872 businesses, 497 (57%) were in agriculture, fisheries and forestry. Construction and real estate were the next most common business types in the shire. The table below shows the size of businesses in Balonne Shire in the agriculture, fisheries and forestry industries in 2009. Over half of businesses in agriculture were non-employing, and only 25 of these 497 businesses employed more than 20 people.

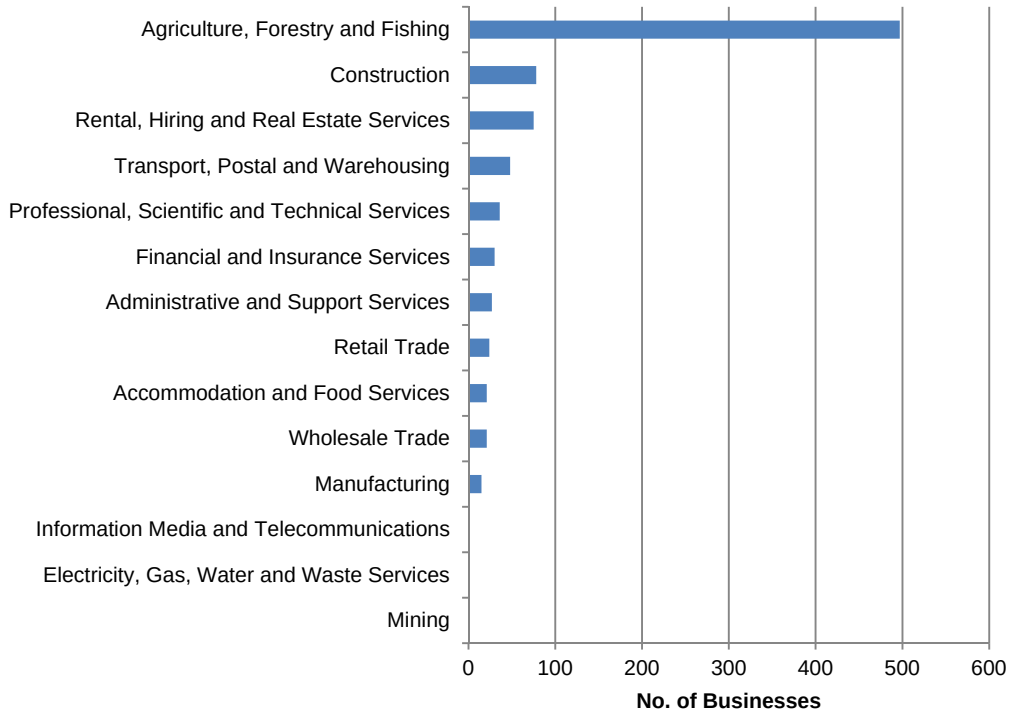

Figure 25 Business counts by industry

Source: Australian Bureau of Statistics 2010

Table 3 Businesses in agriculture

Business Size	Number
Non employing	279
1-4	108
5-19	85
20-49	19
50-99	6
100-199	0
200+	0
Total	**497**

Source: Australian Bureau of Statistics 2010

Implications

Irrigated farming has allowed the St George community to thrive and grow. The significant decline in population from 2001 to 2006 was quite different to the upward trend in population generally experienced by Balonne Shire over the past 30 years. The population increase occurred at a time when irrigated agriculture became a more significant component of the local economy, offsetting climatic variability and the resultant job losses and population decline that have been experienced in other remote communities where dryland agriculture is the dominant land use. However, a regional economy focused in this way is also clearly vulnerable to changes in external circumstances, and the heavy reliance of the shire's economy on irrigated cotton means that variability of production, for example in recent drought years, have significant flow-on impacts in terms of population, employment and income.

In terms of agricultural employment in St George, about 26% of the town's population is employed in agricultural industries, compared to 41% in Balonne shire as a whole. Of the 400 people employed in agricultural industries in St George, about half are farm managers, and there is relatively little flow-on to labouring (1 labourer for every two managers) and 'service to agriculture' which includes activities such as fertilizer spreading, harvesting, agistment and veterinary services . Businesses are predominantly small, but show signs of diversifying in response to drought

St George and its surrounding region are now highly dependent on irrigated agriculture both directly and indirectly as a major source of economic activity and employment; crops account for approximately 60% of the total value of agricultural production. Analysis by Price Waterhouse Coopers in 2000 for the Condamine–Balonne concluded that direct and indirect employment was around 25.5 jobs per thousand hectares, compared to 3 jobs per thousand hectares in dryland farming. In other words, employment intensity in irrigated agriculture is significantly higher than dryland farming.

The Namoi Valley and Gunnedah

Introduction and History

The shire of Gunnedah in the North West of NSW covers an area of 5,092 km^2 and has a population of around 12,000 people. It is part of the Namoi Catchment, located in the upper Namoi valley and with an area of approximately 42,000km^2. Gunnedah was one of the first towns in the Namoi Valley. It was established in the 1850's, and had about 500 residents by 1873. The Liverpool Plains, of which Gunnedah was a part, were an extensive pastoral and cropping district at this time, described as "the best watered district of NSW." As early as the late 1840's squatters, occupying runs and stations had taken up much of the district. The advent of rail to the town in 1879 led to the development of saleyards, which by the early 1900's were busy selling cattle, sheep and horses. By this time Gunnedah also had many shops and services including a post office, a courthouse, a police station, a public school, a coach maker, several hotels and a brewery. Figure 2 shows long-term population growth in Gunnedah shire.

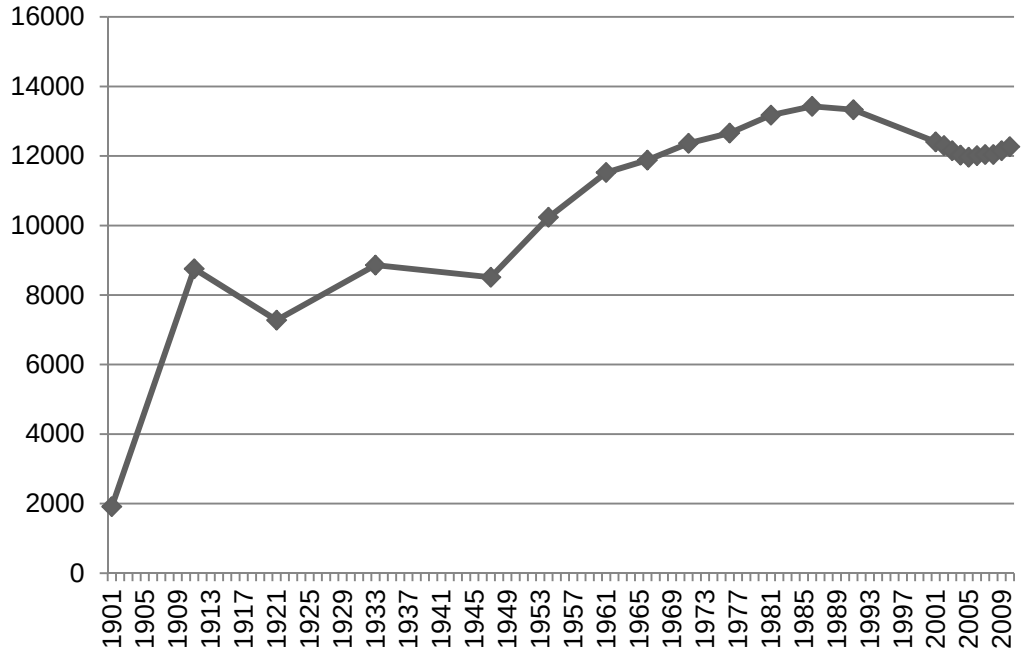

Figure 26 Gunnedah Shire Population

Source: Australian Bureau of Statistics 2006

In addition to its thriving agricultural industry, coal mining around the Gunnedah district began in the 1880's. The history of coal mining in the area has been turbulent, with frequent closures and resultant unemployment, but also with many years of high production. Mining at Gunnedah and nearby Curlewis had several successful years into the early 1900's, but the Curlewis mine was closed after a bushfire in 1905 and didn't resume until 1917. This mine again closed in 1936 because of low prices. Production at Gunnedah boomed in the post-war years but began to decline in the 1950's when demand for coal was reduced by the change from steam to diesel. From an employment peak of more than 200 after the war, numbers fell to less than 40. The Gunnedah Colliery was expanded again in 1960, going through several cycles of "boom and bust" before operations were ceased in 2000.

Gunnedah experienced significant development between 1900 and the First World War. Examples of industry in the town included a meat works, brick works, butter factory and a flourmill. During this time a department store was also established, as well as a town water supply, electricity supply, garbage collection service and a new Union Bank. Similar to many towns in Australia, progress in Gunnedah was slowed by the two World Wars and the years of the Great Depression. One hundred men from Gunnedah died in World War One and 77 gave their life in World War Two, having a significant impact on the town.

In the post-war period, soldier settlement schemes (such as the break-up of Goolhi Station) brought new settlers to the district, wool prices were booming and the community began to grow. During this time Gunnedah built a new aerodrome and established the war memorial baths, which transformed the garbage-dump and rock quarry into a community asset. The Gunnedah abattoir was also established in the 1950's and was continually upgraded up to the 1980's, providing as many as 600 local jobs at any one time.

The opening of Keepit Dam in 1960 and subsequent increase in irrigated agriculture was also important for Gunnedah. Agitation for a dam at Keepit was started as early as 1896 when the Irrigation Commission of the time was looking for a site for an irrigation scheme on the Namoi. The eventual decision to construct a dam was not made until 1937. The construction of the dam was halted several times because of political and funding issues, but within 10 years its eventual completion there were 25,000 hectares of cotton under irrigation in the Namoi Valley. As similar area of wheat, sorghum, Lucerne, vegetables and oilseeds was also being grown.

An important development for Gunnedah in recent times was the first Ag-Quip in 1973. The agricultural field event began with 63 exhibitors, but has grown significantly: The modern-day Ag-Quip draws 600 exhibitors representing around 3000 companies and more than 100,000 visitors from all over Australia and overseas. The event has benefits for local hotels, clubs, cafes and restaurants.

The 1990's were marked by a series of setbacks for the shire. The closure of the abattoir in 1997 due to a downturn in the export meat trade and the loss of operators at the works had a significant impact on employment in the town. In addition, depletion of coal reserves led to the wind-down and eventual close of the Preston, Vickery and Gunnedah coalmines. The domino effect of job losses and departures also led to the closure of the Gunnedah RSL Sports Club. There were also a series of floods (1998 and 2000), which severely affected farmers, and this was followed by record drought in 2002 and several harsh drought years up to 2006.

Despite problems, agriculture has remained the major industry around Gunnedah, with 80% of the shire area devoted to farming. Gunnedah's primary exports are cotton, coal, beef, lamb and pork, cereal and oilseed grains. Recently there have also been two new open-cut mining projects near Boggabri, exploration of the Caroona mining resource by BHP, and the expansion of the existing Whitehaven mine (30km north of Gunnedah).

Agricultural Production

The dominant land use in the Namoi Valley is cattle and sheep grazing. Wheat, cotton and other broadacre crops are grown on the alluvial floodplains. Around 112,000ha were irrigated in 2000 with

around 80,000 ha (or over 70%) used for cotton production. Figure 27 shows the gross value of agricultural production for commodities other than cotton in the Namoi Valley.

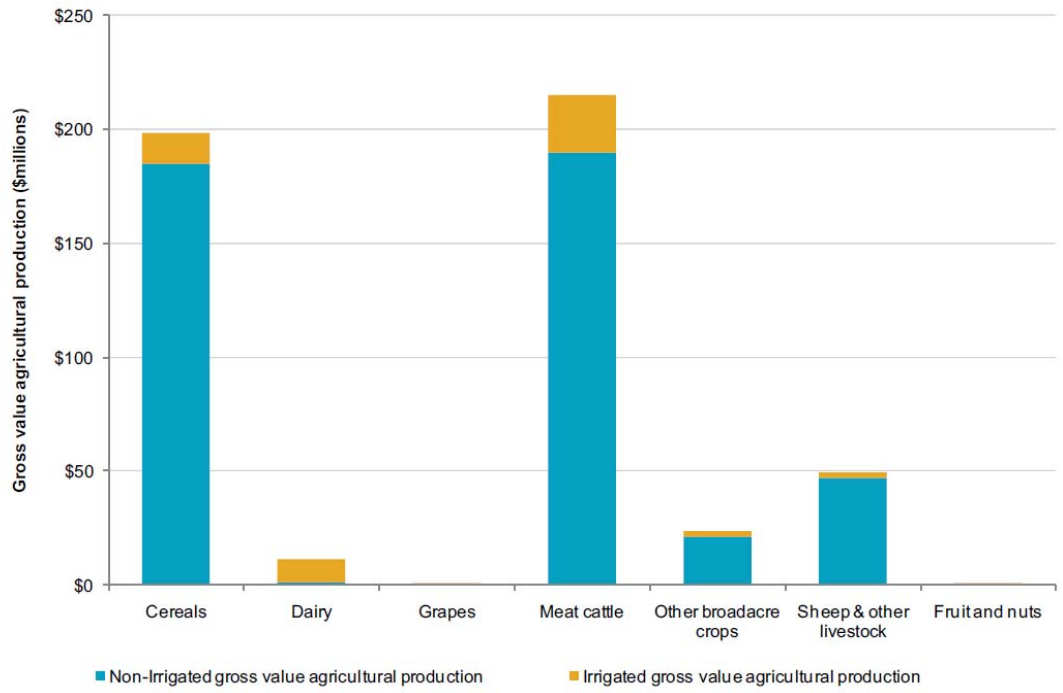

Figure 27 Gross Value of Agricultural Production 2006

Source: Murray-Darling Basin Authority 2010, p 952

In the Namoi Valley, cotton typically accounts for 70–80% of farm income while in any one year it might account for as little as 10% of the farm area. The rest of the farm is typically taken up with other crops, crop fallow areas, pastures, roads, irrigation channels, dams and native vegetation. Wheat, sorghum and beef cattle are often part of the enterprise mix (Murray-Darling Basin Authority 2010).

Cotton is an expanding industry around Gunnedah; there are over 60,000 hectares of cotton grown in the Namoi Valley and 7 cotton gins, mainly operated by Namoi Cotton. Between 2000 and 2008, production in the Upper Namoi ranged from 56,705 bales to 190,000 bales ginned. The average production over this time was 104,000 bales. In 2006 there were around 45 growers in the Upper Namoi.

Despite its growth, the industry is also susceptible to considerable variability. Cotton plantings and yields can vary significantly from year to year, depending on factors such as water availability, temperature and insect/disease pressure. Figure 28 below shows area planted in the cotton growing regions of NSW between 2000 and 2009. Compared to the Lower Namoi, cotton production in the Upper Namoi is relatively small but less variable reflecting its diverse agricultural mix and reliable water sources (Roth 2010). Cotton price is also highly volatile, and The Australian recently reported that Namoi Cotton has suffered significant losses on cotton futures (December 30 2011).

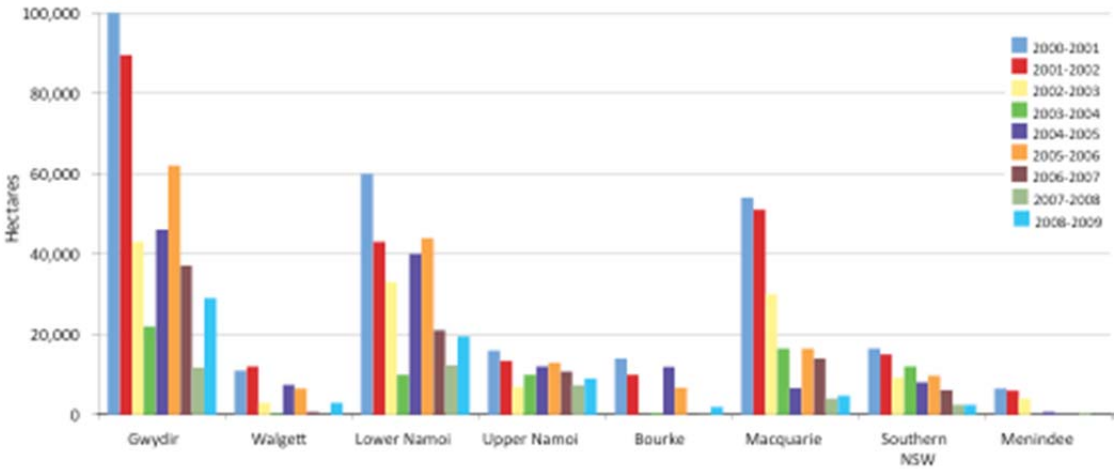

Figure 28 Area of Cotton in NSW

Source: Roth 2010

Employment

For the Namoi region as a whole, there were 39,298 people employed in 2006, of which 5,455 people (13%) worked in agrculture, fisheries and forestry, making it the biggest employing sector. Retail trade (11%) and health care (11%) were the next biggest employers.

Figure 29 shows the number of people employed by industry in the Gunnedah Shire, and Figure 30shows the occupations of those working in agriculture. In Gunnedah Shire in 2006 there were 4,532 employed persons, of which 852 were employed in agriculture, fisheries and forestry (18%). The next biggest employing sectors were retail trade (11%) and health care and social assistance (10%), respectively. Of those working in agriculture in Gunnedah, most identified their occupation as managers or labourers.

With regard to farms, 245 of those people employed in agriculture in Gunnedah identified themselves as mixed crop and livestock farmers (29%), while there were 106 grain or pasture growers (12%), 91 beef cattle farmers (10%) and 17 cotton growers (2%).

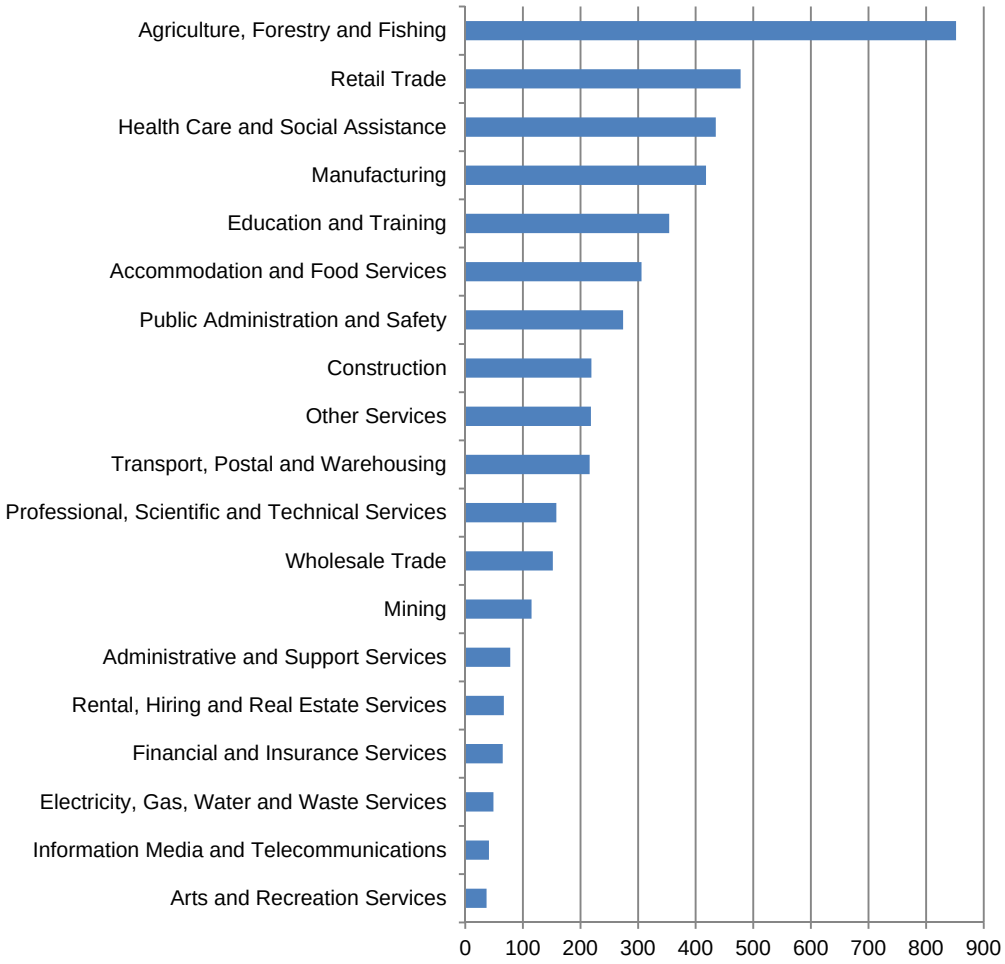

Figure 29 Employment by Industry in Gunnedah Shire

Source: Australian Bureau of Statistics 2006

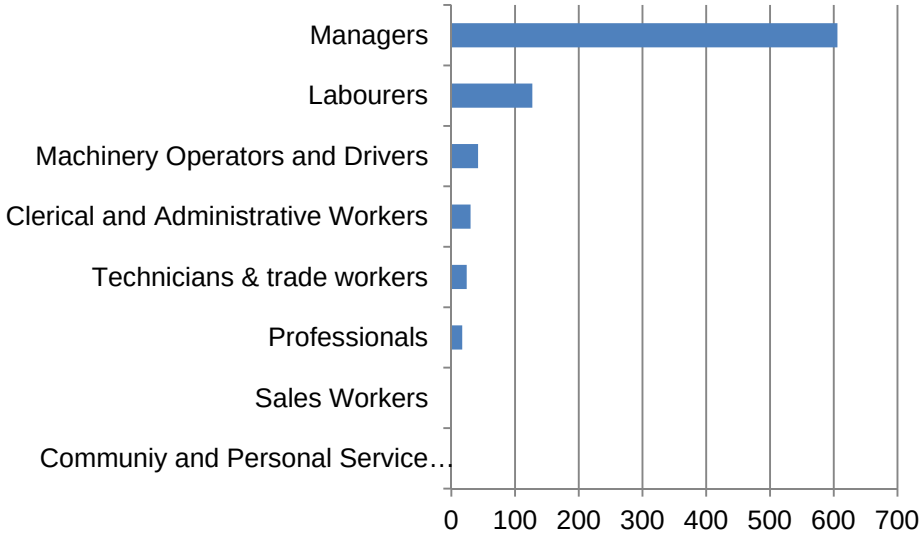

Figure 30 Employment by Occupation in Agriculture, Gunnedah Shire

Source: Australian Bureau of Statistics 2006

Business

Figure 31 shows the number of businesses in Gunnedah Shire in 2009. Of total 1533 businesses, 751 (49%) were in agriculture, fisheries and forestry. Construction (11%) and real estate (8%) were the next most common business types in the shire. Table 2 below shows the size of businesses in Gunnedah Shire in the agriculture, fisheries and forestry industries in 2009. Over half of businesses in agriculture were non-employing, and all of the agricultural businesses in the area employed less than 20 people.

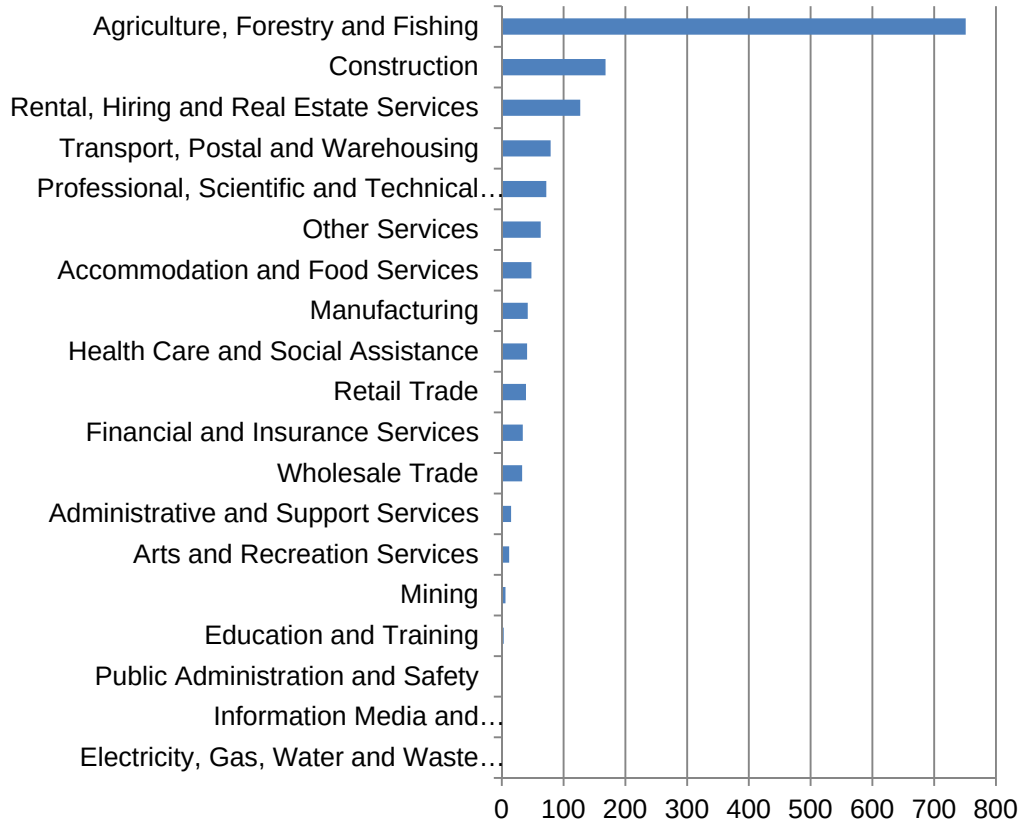

Figure 31 Business Counts by Industry in Gunnedah Shire

Source: Australian Bureau of Statistics 2010

Table 4 Businesses in Agriculture, Gunnedah Shire

Business Size	Number
Non employing	540
1-4	159
5-19	52
20-49	0
50-99	0
100-199	0
200+	0
Total	751

Source: Australian Bureau of Statistics 2010

Implications

Gunnedah's history reveals a town that has had a relatively diverse and dynamic economy, both within and outside of the agricultural sector. Despite long term population growth, in recent times Gunnedah has experienced major economic changes, including drought and the closure of the local abattoir and mine, which have led to the town experiencing large employment losses and economic downturn compared to the rest of the Namoi (Schofield & Ferguson 2005).

Like St George, a major part of the total value of Gunnedah's agricultural output is in cotton, the production of which can be highly variable. However, Gunnedah has a more diverse agricultural base, more reliable irrigation water and is less isolated from larger population centres (for example, Tamworth is only 100km away). The fertile soils and groundwater supply support a very large livestock industry, as well as summer and winter cropping including wheat, barley, canola and cotton. Greater proportions of labour in industries such as retail trade, education, professional services and manufacturing also mean that the overall impacts of drought on population and employment are softened.

Similar to St George, Gunnedah shire has a high proportion of managers in its agricultural employment base (70%), and there is even less flow-on to labouring than in St George. Businesses are predominantly small, with no businesses in agriculture in 2006 employing more than 20 people.

Waikerie and the Riverland

Introduction and History

Waikerie is a small town located on the southern bank of the Murray River in the Loxton-Waikerie Shire, about 140 km northeast of the outer suburbs of Adelaide. The town is part of the Riverland Region, with other major centres including Renmark, Loxton, Barmera and Berri. The population of the Riverland is around 33,455 and is relatively evenly spread, with 34% in Berri Barmera Shire, 36% in Loxton-Waikerie Shire and 29% in Renmark-Paringa Shire. The long-term population growth of Waikerie-Loxton is shown below.

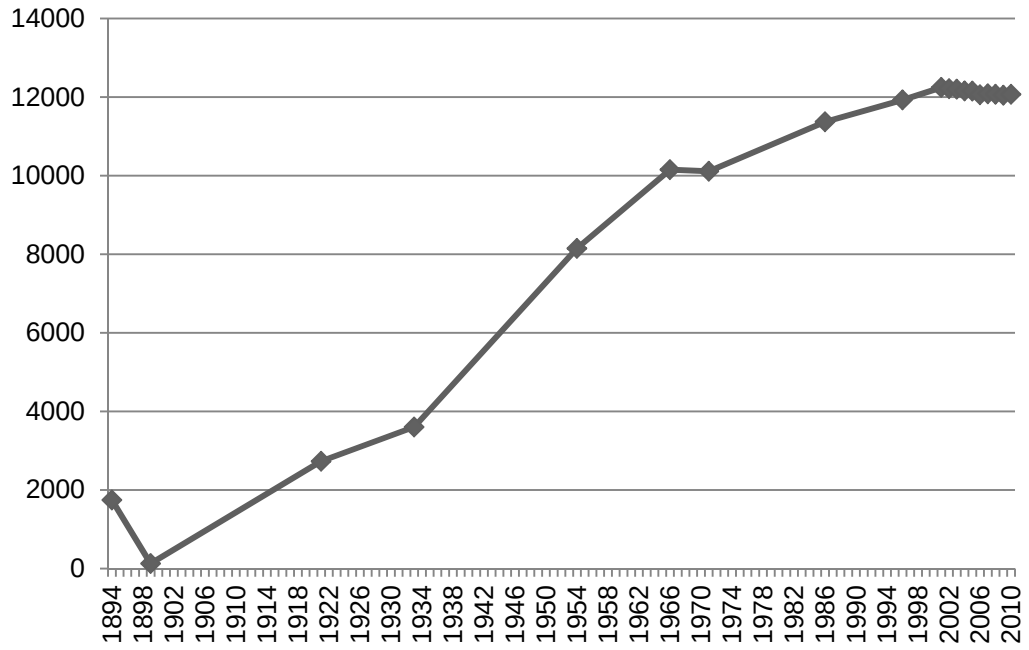

Figure 32 Population Waikerie

Source: Australian Bureau of Statistics 2006

Note: First two data points are for all village settlements, after that data is for combined Waikerie and Loxton Councils or Loxton-Waikerie Council.

Waikerie was established as a station around 1880, and used for grazing of sheep and cattle, as well as cropping. Early irrigation pumps were erected at this time. Constant cycles of drought and flood were a feature of the landscape, and a severe drought between 1880 and 1886 led to increased interest in irrigation in the district.

River settlements were encouraged after the economic depression of 1890-1893, to help alleviate unemployment and to make use of 'wastelands' for irrigation. Several settlements were started around the district including Waikerie, Holder and Ramco. The early settlers were optimistic and planned to produce dairy and pork for market, and to increase fruit tree plantings each year. But early settlers were on the whole ill prepared for the rigours of bush life. Despite very difficult conditions, by 1895 there was wheat being planted and 600 acres of land cleared. In 1894 there were 1748 people in the settlements (Waikerie, Ramco, Holder, New Era).

In 1899 there was a commission into the river settlements. Very difficult conditions meant that since 1884 the population in Ramco, Waikerie and Holder had been reduced to 129 with only 13 adult males at Waikerie. Considerable wheat had been planted but the settlements had only 79 acres of fruit trees and vines. By 1901 land around the settlements were being leased as horticultural blocks for individual development, and irrigation was gradually improved. Settlers were advised to concentrate on orchards and vineyards and irrigation projects to secure practical returns. When all surveyed blocks were opened for selection there was an influx of new settlers, some with capital. By 1903 all nineteen blocks at Waikerie were leased.

During 1908 there were many men seeking grape picking work, travelling by boat and foot. At this time some were advocating the building of locks on the river to provide a permanent waterway for transportation and production. Some argued the Murray valley could support a population of 500,000 with mass production of fruit, wool and wheat. An extended irrigation scheme for the district around Waikerie was begun in 1909. Waikerie was recognised as a township in 1910, and there was sale of new blocks and town allotments. Culture of citrus fruit was not undertaken on a large scale until 1910.

In the years after the First World War there was steady growth in Waikerie, and the estimated population of the township in 1923 was over 1500 people. The town at this time had a hotel, a hospital, a large distillery, two fruit packing sheds and a preserving factory.

The Great Depression of the 1930's affected the entire population of Waikerie, including the farming community. Many farmers were in financial difficulty because of falling prices for cereals and wine (bonuses were paid by the Government to help the growers). The town saw out the depression and Second World War in relative hardship, After the Second World War the town began to develop further, and in 1960 and 1961 the Waikerie Irrigation Lands Extension Committee, working as a non-profit company, developed the irrigation land now called Golden Heights and Sunlands (to the south and to the northwest of Ramco, respectively). The Golden Heights scheme was the first large-scale co-operative scheme to adopt the permanent spray principle. Development of overhead systems greatly increased the amount of land available for horticulture production. Sunlands in particular attracted many newcomers to the area; it was owned by 59 people and was expected to add 500,000 pounds to the State's annual income from primary products. In 1965 the Waikerie irrigation area totalled 10,669 acres and the population of the district was about 3,200. Production in 1963-64 comprised 419t of dried vine fruits, 9,755t of grapes for wine, 272t of dried fruit, 158,922 cases of fresh deciduous fruits and 442,750 cases of citrus.

There was substantial development in Waikerie during the 1960's and 1970's including a new swimming pool, juicing plant, upgrading of the civic centre, hospital expansions and a senior citizens home. The World Gliding Championships were held in Waikerie in 1974 and resulted in a $50,000 dollar upgrade to the Waikerie Aerodrome. In 1974/5, 105 building applications were received and in 1975/76, 211 applications were received (for structures worth $1,701,510). By 1990 it was suggested that some Navel and Valencia properties were worth $20,625 per hectare.

In the period from 1998–99 to 2007–08, irrigators in the SA Murray faced drought and low water allocations (particularly from 2006–07 when allocations to SA Murray high-security entitlements fell to 60%), adjustment in the dairy industry (from the early to mid-2000s), and the simultaneous downturn in the wine and citrus industries from the mid-2000s (National Water Commission 2010). In Waikerie, this has led to economic stagnation that is in contrast with Loxton-Waikerie's growth over the last century, which has continued steadily. A feature of development in the region has been the continual improvement of irrigation and farming techniques and heavy dependence on the water of the Murray River.

Agricultural Production

The regional economy of around $2.2 billion has a high dependence on irrigation, with wineries, packing sheds and other food processing reliant on a consistent supply of irrigated crops. There are currently an estimated 3,000 growers and 33,455 people living in the region. More than one in three employed people in Waikerie work directly in the agricultural sector, with the main enterprise being grapes and citrus. The total gross value of agricultural production in Waikerie-Loxton Shire in 2006 was $366.2 million.

The Riverland is Australia's largest wine producing region, growing in excess of 50% of South Australia's wine grapes. The Waikerie area is home to such brands as Banrock Station and Kingston Estate amongst others. The Riverland region is also well known for its production and processing of citrus, stone fruit, almonds and vegetables. The location of horticultural quality soils adjacent to the Murray is a key advantage for the area. Figure 33 shows the gross value of agricultural production in the Riverland Region.

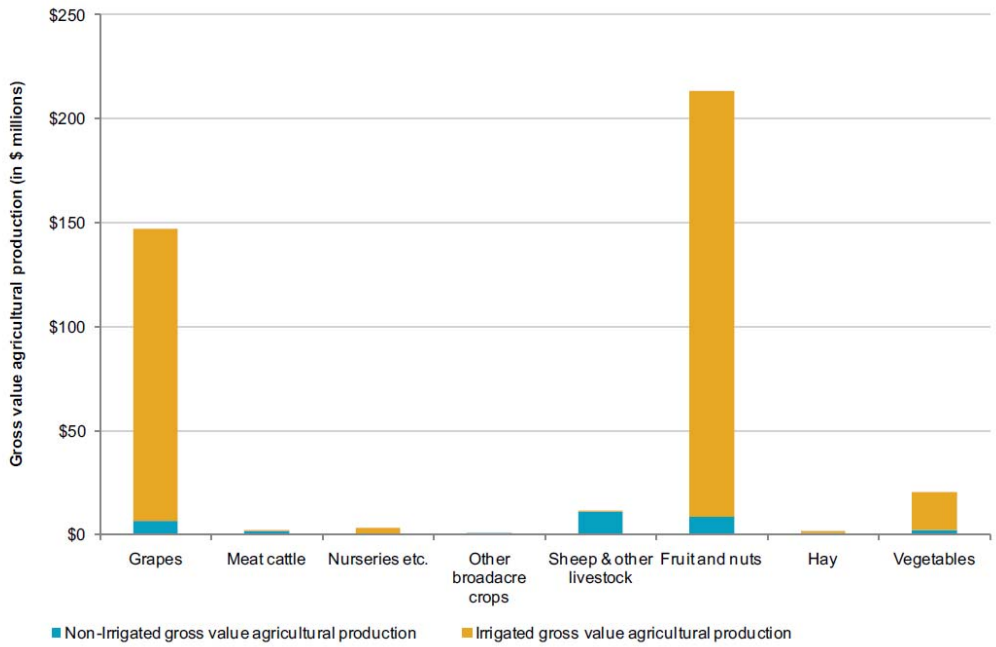

Figure 33 Gross Value of Production in the Riverland Region 2006

Source: Murray-Darling Basin Authority 2010, p 1042

Employment

In 2006, there were 5,493 people employed in Loxton-Waikerie SLA. In the township of Waikerie, there were 655 persons employed, of which 102 (16%) worked in agricultural industries. Figure 34 shows the number of people employed by industry in Waikerie, and Figure 35 shows a comparison of employment in Waikerie and Loxton-Waikerie Shire. It can be seen that for both the shire and for Waikerie, agriculture, retail and health care are the major industries of employment. However, the Loxton-Waikerie Shire has a much higher proportion of people in agricultural industries (about 27%) compared to Waikerie, which has a greater proportion of services. This reflects the fact that most agricultural holdings are outside of the town.

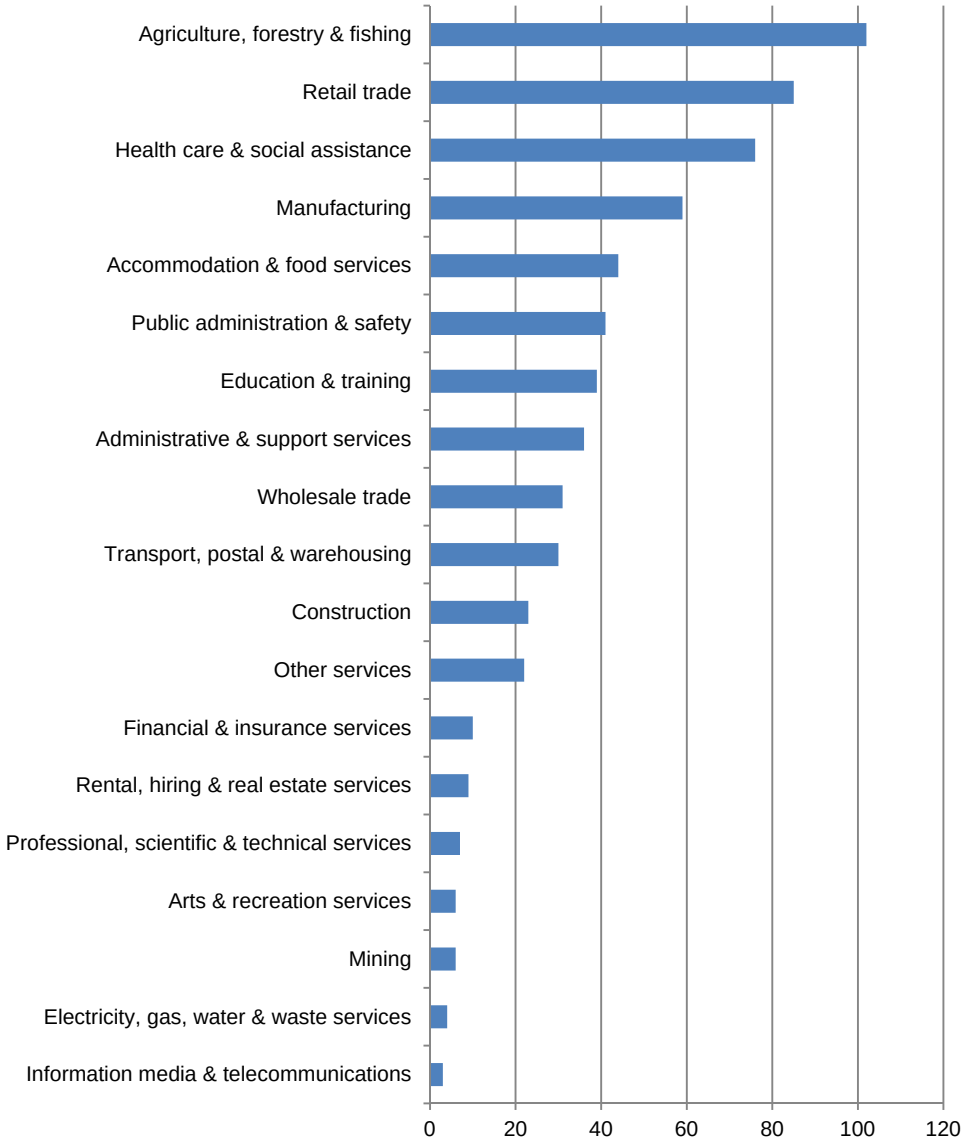

Figure 34 Employment by Industry in Waikerie

Source: Australian Bureau of Statistics 2006

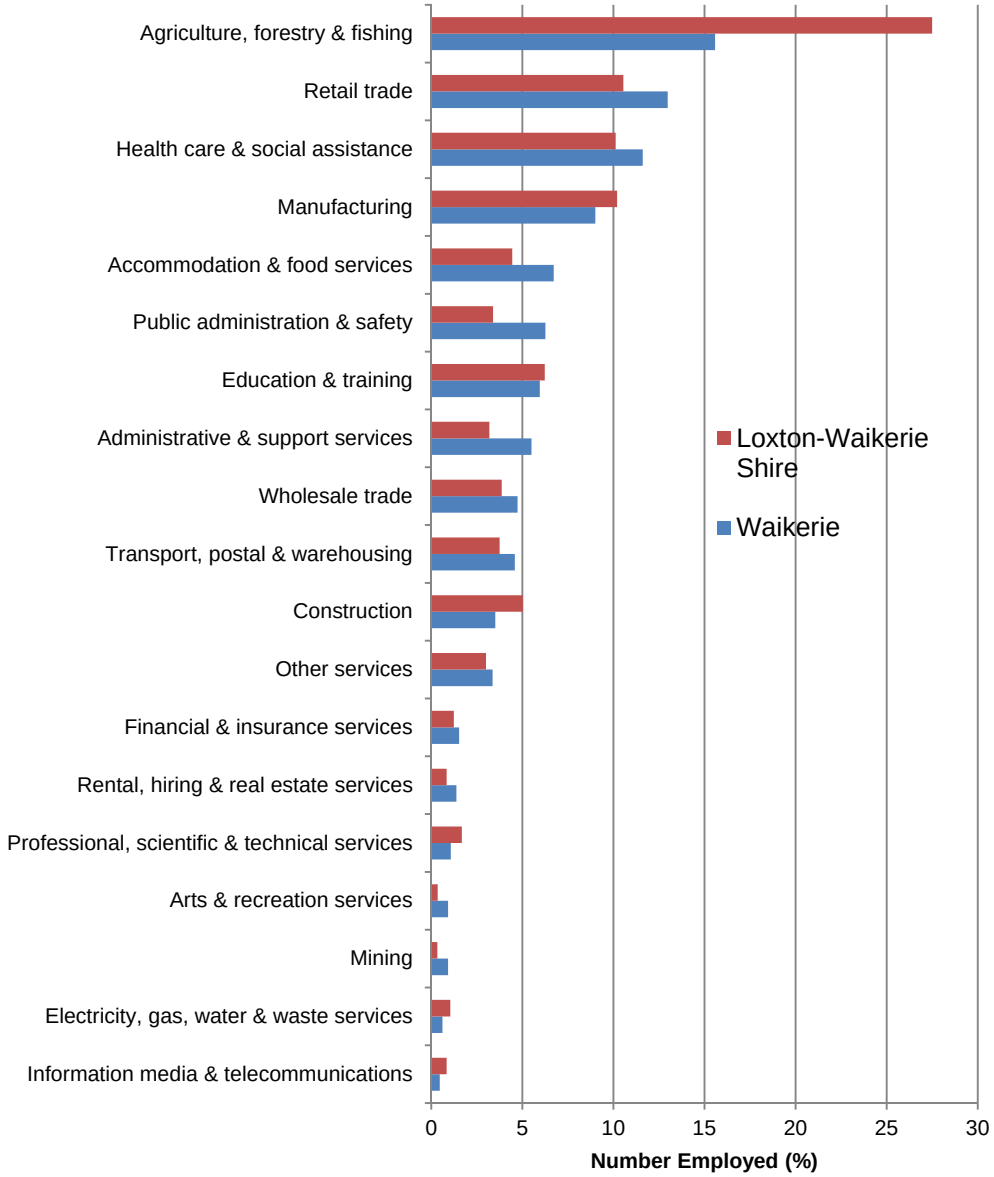

Figure 35 Employment by Industry for Waikerie Township and Loxton-Waikerie Shire

Source: Australian Bureau of Statistics 2006

Figure 36 shows the number of people employed in broad agricultural occupations in Waikerie, and Figure 37 shows the most numerous specific agricultural occupations in Loxton-Waikerie Shire. It can be seen that the majority of agricultural workers in the town are labourers (72 persons), while managers are the next most numerous employment type. This contrasts with Loxton-Waikerie Shire as a whole, which has 829 managers (54%) and 522 labourers (34%) in agricultural employment. The most numerous farmers in Loxton-Waikerie Shire in 2006 were fruit or nut growers (283), followed by mixed crop and livestock farmers (217), and grape growers (214). Workers for these industries made up most of the other agricultural employment in the shire.

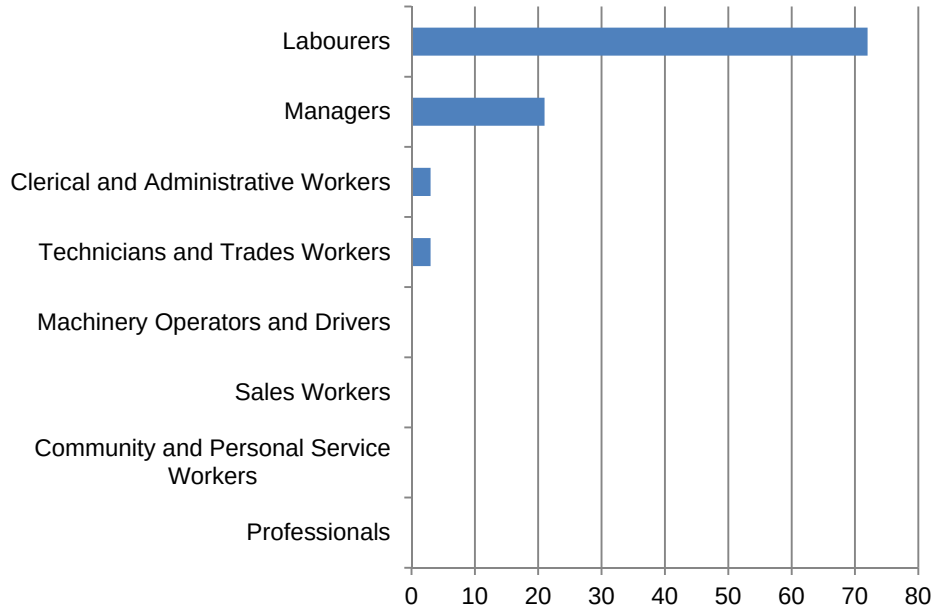

Figure 36 Employment by Occupation in Agriculture, Waikerie

Source: Australian Bureau of Statistics 2006

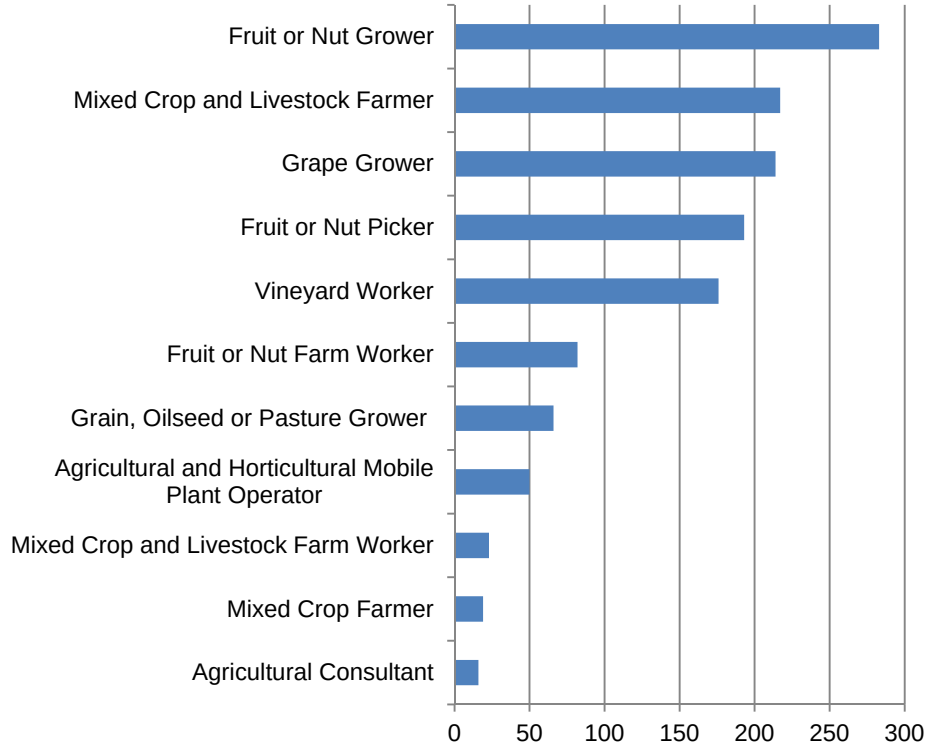

Figure 37 Agricultural Occupations in Loxton-Waikerie Shire

Source: Australian Bureau of Statistics 2006

Business

Figure 38 shows the number of businesses in Loxton-Waikerie Shire in 2009. Of total 1268 businesses, 670 (52%) were in agriculture, fisheries and forestry. Retail trade (8%) and construction

(8%) were the next most common business types in the shire. Table 3 below shows the size of businesses in the Shire in the agriculture, fisheries and forestry industries in 2009. Over half of businesses in agriculture were non-employing, and most of the agricultural businesses in the area employed less than 20 people.

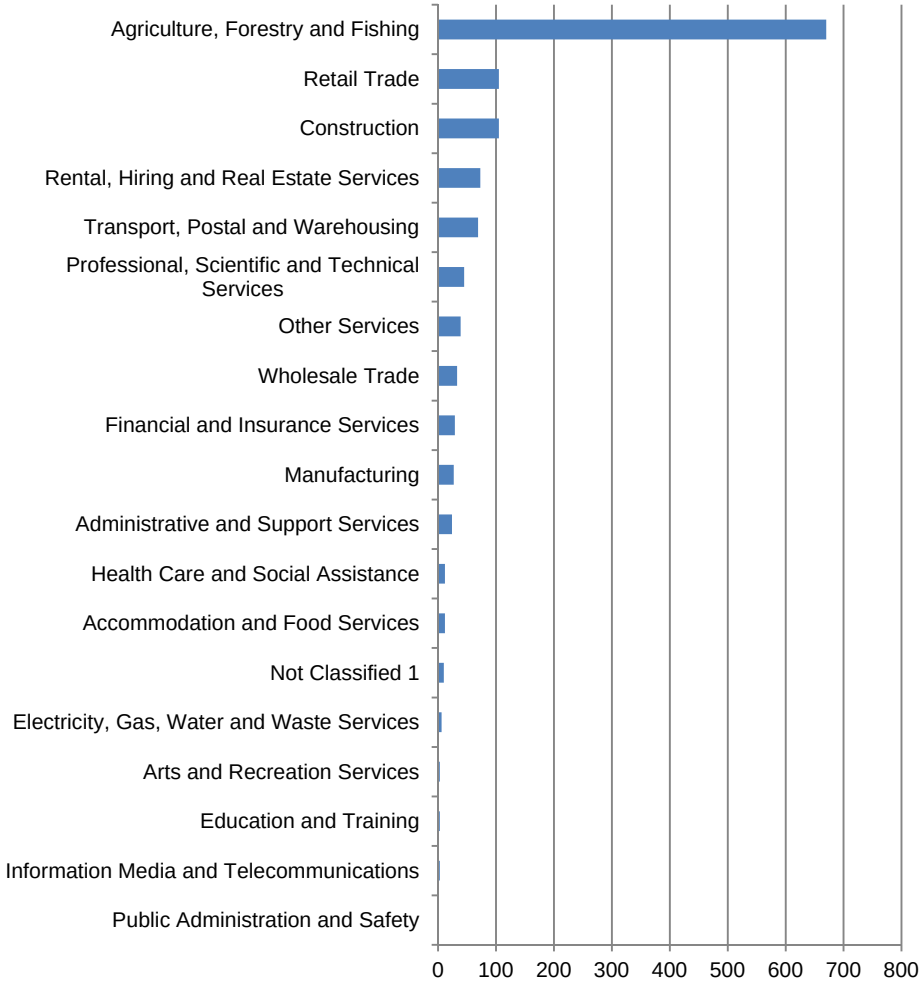

Figure 38 Business Counts by Industry, Loxton Waikerie Shire

Source: Australian Bureau of Statistics 2010

Table 5 Agricultural Businesses, Loxton-Waikerie Shire

Business Size	Number
Non employing	348
1-4	160
5-19	135
20-49	27
50-99	0
100-199	0
200+	0
Total	**670**

Source: Australian Bureau of Statistics 2010

Implications

Waikerie's progress from almost unliveable to a large town has been entirely reliant on the development of irrigation farming. Similar to St George, irrigation has allowed growers in Waikerie to offset climatic variability and the resultant job losses and population decline that have been experienced in other remote communities where dryland agriculture is the dominant land use. Waikerie's economy is now highly dependent on the Citrus and Wine industries, the combination of which make up much of the employment in the area. In the last fifty years, the overall development of the town and surrounding industries has been strong.

In the past decade, the wine and citrus industries around Waikerie have faced major challenges. The wine industry in the Riverland differs from the nearby Barossa Valley in that it is made up of larger vineyards that cater to lower quality wine markets. The CCW Limited (2011) has found that the average price of wine grapes per tonne in 2002 was $674 compared to $274 estimated value per tonne in 2011, which is currently below the long-term cost of production. The low returns have had a strong impact on growers, with many leaving the industry. The area under vineyard in the Riverland has decreased by 18% over the past 4 seasons, and CCW Co-op shareholder base has declined from 741 members in February 2004 to 612 members in 2011.

The citrus industry has also faced major structural and economic challenges in the last ten years. Over supply and low prices, combined with rising cost of production and uncertain water availability, have been major issues. Growers rely heavily on export markets (fresh fruit), and the recently high Australian dollar has meant that these markets have reduced significantly. Anecdotal evidence suggests that orchard land prices have been falling, and that many farmers have been experiencing significant financial loss on crops.

In terms of agricultural employment in Waikerie, about 16% of the town's population is employed in agricultural industries, compared to almost 30% in Loxton-Waikerie shire. Of the 102 people employed in agricultural industries in Waikerie, only about 20 are farm managers, and there is significant flow-on to labouring (3 labourers for every manager). This balance is different in the shire as a whole, with growers being most numerous. Like the other shires, businesses are predominantly small, but there are significantly more large businesses in Loxton-Waikerie than in Gunnedah or Balonne. The figures at the shire level are difficult to generalise because Loxton and Waikerie have very different economic characteristics.

Supply Chains in the Study Areas: Cotton, Citrus and Wine

Cotton

The figure below shows a simple representation of the cotton supply chain in St George and Gunnedah. Cotton moves along the middle line from growers to gins (where fibre is separated from the seed) and then to buyers. The major buyers of Australian cotton (in order) are currently China, Indonesia, Thailand, South Korea, and Japan, and there is no government intervention in the growing or marketing of the crop (Roth 2010).

Queensland Cotton operates the three gins in the St George/Dirranbandi area, and also provides marketing services to many growers. The Namoi Cotton Cooperative is the main gin operator and marketer in Gunnedah. Most of the services required by the growers in both areas, such as machinery, agronomy and chemical supplies, are provided by local businesses. Growers use freight and contract labour from outside sources but in many cases may also provide these services for other growers.

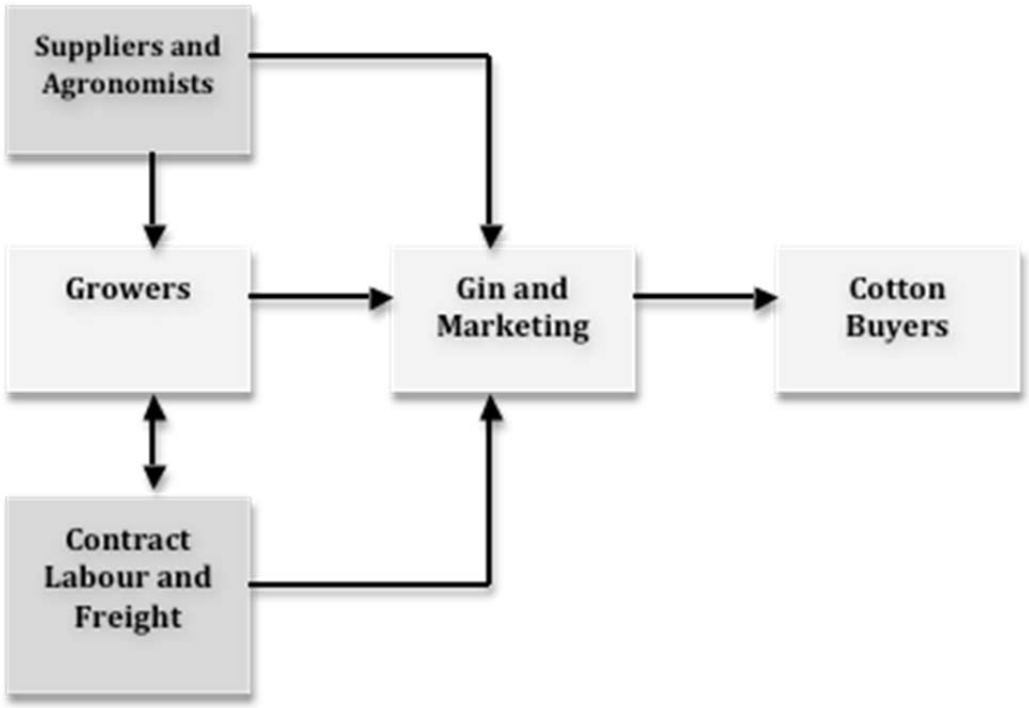

Figure 39 The Cotton Supply Chain

Citrus

The diagram below shows a simple representation of the citrus supply chain.

Fruit is processed into juice or packed as fruit and then either exported or sold in local supermarkets and grocers. As in St George and Gunnedah, inputs for growers in Waikerie are mainly provided by local businesses. Companies such as Nippy's and Crusta Juices also process and pack fruit locally and regionally.

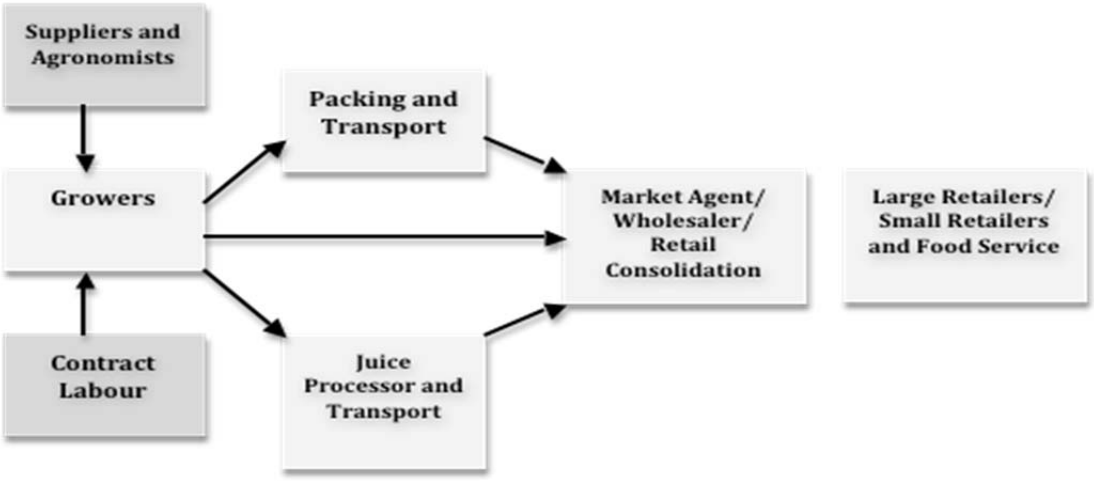

Figure 40 Citrus Supply Chain

Wine

The below diagram is a simple representation of the steps in the wine supply chain. The wine supply chain is highly fragmented, and combinations of particular stages in the wine making process can be carried out by single entities (for example, a wine producer may also grow and harvest their own vineyards). Vineyards around Waikerie are mainly large and supply to industrial wine makers (for

example, Boars Rock Winery) for export as a generic product. This is in contrast to "value chain" producers that operate on a smaller scale and target boutique markets.

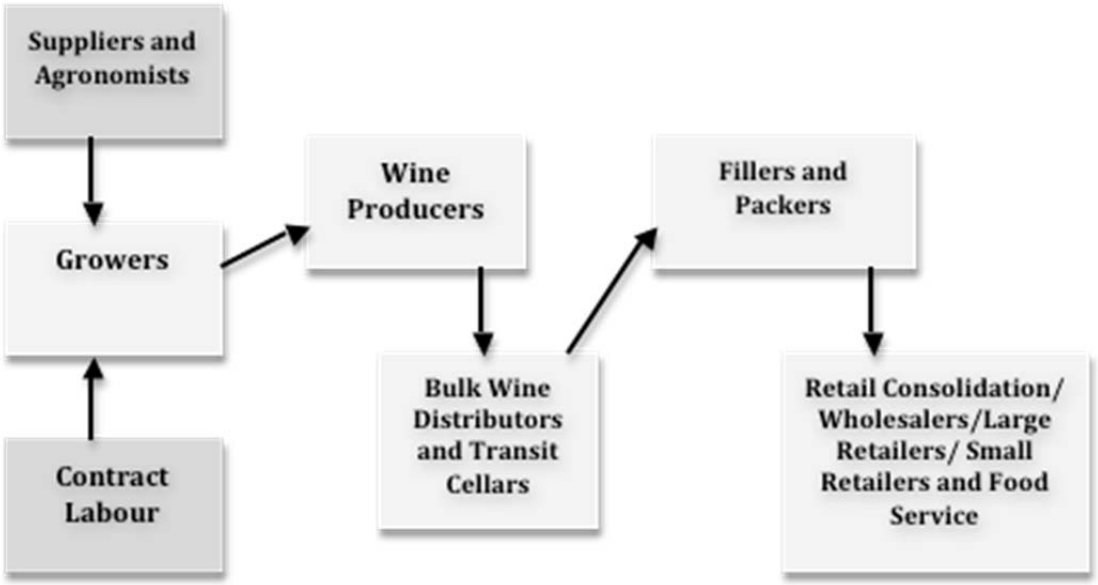

Figure 41 Wine Supply Chain

Cotton Businesses in St George

A cross section of businesses in the local St George cotton supply chain was interviewed for this study. The following tables provide a snapshot of business operations in the area.

Table 6 Cotton Businesses, St George

Supply Chain Business	Time Operating in the Area	Importance of Cotton production to Operation	Average Yearly Turnover	Employment
Machinery Business 1	15 to 25 years	Very Important (60-90% of income)	Over $2 million	18 full time staff
Supply and Agronomy 1	More than 25 years	Not Important (Less than 10% of income). Other activities are grapes, animal health, general merchandise	Over $2 million	7 full time, 2 casual
Supply and Agronomy 2	15 to 25 years	Very Important (60-90% of income)	$30 million	5 full time
Supply and Agronomy 3	15 to 25 years	Very Important (60-90% of income)	Over $2 million	3 full time, 1 casual
Aerial Spray 1	More than 25 years	Crucial (More than 90% of income)	Over $2 million	15 full time, 6 contractors (FTE)
Ground Spray Contracting 1	5 Years	Very Important (60-90% of income)	$250,000 - $1 million	2 full time, 1 part time
Cotton Gins and Marketing in St George/Dirranbandi	More than 25 years	Crucial (More than 90% of income)	Over $100 million	22 full time, 104 casual from March-July plus 9 marketing staff for the entire business (12 gins), 1 for the St George area

Table 7 Growers, St George

Grower	Time Farming in the Area	Scale of Production	Other Land Uses	Water Allocation	Best Profit in the Last 5 Years	Employment
Grower 1	15 to 25 years	178ha at 12 bales/ha or 1.1 bales/ML	None	2900 Ml General Security plus flood harvesting (200ML used last season)	$150,000-250,000	3 full time, 8 casual (for harvest)
Grower 2	15 to 25 years	715ha at 11.3 bales/ha or 1.7bales/Ml	Cattle (300 head)	3360Ml General Security plus flood harvesting (3500 Ml used last season)	$150,000-$250,000	6 full time, 2 full time contractors, 1 casual
Grower 3	More than 25 years	396ha at 12.6 bales/ha or 2 bales/Ml	None	2300Ml General Security plus flood harvesting (2500Ml used last season)	$250,000 to $499,999	3 full time

Managing Change

The three farmers interviewed in St George were asked about their management decisions in the last five years and in the next five years. In the last five years (including some poor seasons) they had all decreased their irrigated area, changed the crop mix of their irrigated production, and improved or made plans to improve water efficiency. Planning for the next five years was much less uniform, and all farmers interviewed made the point that often management decisions were not planned but had to be made due to water availability and other seasonal conditions. The table below summarises some of their comments regarding the recent drought.

Table 8 Managing Change, St George Growers

	Strategies for Managing Change
Grower 1	Alternative crops were grown in the drought to provide income. Sunflowers, chick peas and mung beans have all provided good yields. The agronomic ability to move these crops around depending on timing and amount of water available is getting better. "I didn't lay off staff [during the drought] because I knew that they were going to be hard to replace, and I had one fella coming up for retirement anyway, and it's very hard to pelt [sic] someone for two years and then say can you come back now…..everyone knew that we should be decreasing staff but I actually decreased hours and I worked around it that way……."
Grower 2	The area of cotton is decreased only when forced by water availability. Staff were reduced for a time during the drought, down to 1 permanent for five to six years. At the lowest point in the drought the farm was down to 100 ha of cotton production, and in this year corn and sunflower were also grown.
Grower 3	More opportunity crops were planted during the drought. This grower also did some labour contracting at Cubbie Station for 8 months. Machinery is not replaced during the drought. This creates a cost later on. Employees were decreased (most of the time by retaining staff who wanted to stay). Had to give notice only during two years in 2006/07. Also greater proportion of casual staff was employed during the drought.

Farmers were also asked to predict their actions if water availability (and its impact on cotton related businesses) was decreased or increased by 10, 25 or 50%, respectively. The results for farmers are shown in the tables below. While the sample size is small, it is possible to see a pattern of individual decision making, where small decreases to water availability can trigger changes to crop management, production area and on-farm labour requirements, while large decreases may force sale of assets and seeking other income sources. Conversely, labour requirements and crop management are also affected by relatively small increases.

Table 9 St George Growers Management Action for Decreased Water Availability

	Decrease in Water Availability		
Possible Actions	**10%**	**25%**	**50%**
Increase Borrowings	1	1	
Sell Business Assets		1	
Sell Private Assets			1
Seek Other business income		1	1
Seek Other employment			1
Reduce Labour	1	1	1
Decrease Plantings	1	2	
Change Crop Mix	1	1	
Sell Water	1		
Leave Farming			1
Leave Community			1

Table 10 St George Growers Management Action for Increased Water Availability

	Increase in Water Availability		
Possible Actions	**10%**	**25%**	**50%**
Increase Borrowings		1	
Repay Debt	2		
Buy Business Assets		1	1
Buy Private Assets			1
Seek Other Business Income			2
Less Employment			
Increase on-farm Labour	1	1	
Increase Plantings		2	
Change Crop Mix	1		1
Sell Water Entitlements			
Buy Water Entitlements	1	1	
Leave Farming			
Leave Community			

Businesses in the St George Cotton Supply Chain were asked a similar question to farmers i.e. to predict their actions if cotton related businesses was decreased or increased by 10, 25 or 50%, respectively. Results for all businesses except the gin are summarized in the tables below. It can be seen that for decreases in cotton related business, the trigger point for most actions tended to be higher i.e. 25 or 50%. Increased cotton business was likely to have positive affects from 10% onwards. These results are supported by comments from businesses regarding how they managed change during the recent drought, which are summarized in Table 11.

Table 11 St George Businesses Management Action for Decreased Cotton

	Decrease in Cotton Business		
Possible Actions	**10%**	**25%**	**50%**
Increase Borrowings			1
Sell Business Assets		1	1
Sell Private Assets			1
Seek Other business income	1		4
Seek Other employment			2
Reduce Staff		1	3
Move to a smaller premises or reduce operation		1	2
Close the Business			1
Leave Community			1

Table 12 St George Businesses Management Action for Increased Cotton

	Increase in Cotton Business		
Possible Actions	**10%**	**25%**	**50%**
Increase Borrowings	1	1	
Repay Debt		2	1
Buy Business Assets		2	1
Seek Other business income	1	1	
Seek Other employment			
Increase Staff	1	2	2
Move to a bigger premises or increase operation	1	1	1
Leave Community			

Table 13 Managing Change, St George Businesses

	Strategies for managing change
Machinery Business 1	The recent drought greatly impacted this business, which was operating at 30% of where it is at present (after a few good seasons). Business branches in other towns help to insulate and spread risk. No one was fired during the drought, staff can be moved to other branches (although this is not ideal) or simply not replaced when they retire or move on.
Supply and Agronomy 1	This business is not greatly affected by changing cotton production. During the recent drought, staff levels were maintained and other areas of the business prospered.
Supply and Agronomy 2	This business is a major agronomy supplier in the area, servicing 25-30 growers. During the drought the business went back to 2-3 staff at its lowest point. The business also tried to diversify into other broadacre landuses to maintain income.
Supply and Agronomy 3	This business became less active and reduced its turnover during the drought. Work was carried out on more of an ad hoc basis when required.
Aerial Spray 1	Changing cotton production leads to decreases in staff and contracted pilots, as well as possible sale of aircraft. The business was able to diversify into more bushfire associated work during the drought period. Firebombing also provides some extra income during the summer months.
Ground Spray Contracting 1	This business has scaled down from 5 employees since the drought. There are several factors making this form of contracting much less viable than in previous decades, including improved plant varieties, improved operating efficiency of farmers (meaning decreased land parcels and operating times), increased competition (with more farmers owning machinery and contracting to neighbours etc.There has been a significant increase in the cost of machinery with little increase in the price paid to contractors.
Cotton Gins and Marketing	The gins have several ways of managing decreased production, including putting off casual workers, reducing operating hours, operating gins at night (off-peak power), diversifying into grain storage, contracting employees to neighbouring businesses, and closing gins. When less gins are operated due to less production, it is at a greater cost to the grower due to increased freight.

Water Use in the Balonne

Water variability in the Lower Balonne is higher than much of the Murray– Darling Basin and the bulk of irrigated agriculture, particularly cotton, in the Queensland part of the Lower Balonne relies extensively on harvesting of river flows and floodplain diversions. Water is moved via a river distribution system and approximately 114 km of unlined channels, and the remaining economic life of major irrigation infrastructure is estimated to be 75 years (Murray-Darling Basin Authority 2010).

Figure 42 shows water variability and averages in the Lower Balonne. The estimated mean annual diversion (MAD) of water for the Lower Balonne is approximately 420 GL. The MAD represents a modelled long run average volume of water available for consumptive use. The average volume of water actually used in the Lower Balonne for the period 1995–96 to 2006–07 was 226,986 ML per year highlighting the relative dryness of this period. This comprised estimated average volumes of 67,244 ML/year for regulated use, 2,407 ML/year for unregulated use and 157,335 ML/year for water harvesting.

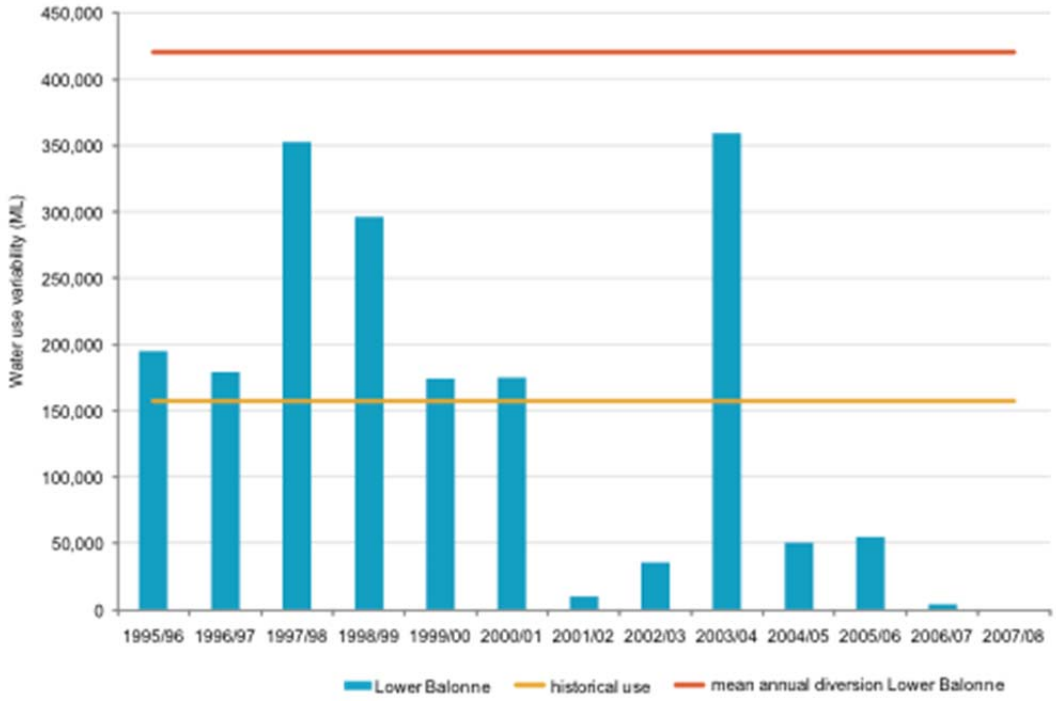

Figure 42 Water Use in the Lower Balonne

Source: Murray-Darling Basin Authority 2010

The variability in water use, water availability and production is highlighted in Table 14 and in Figure 43. It can be seen that yields are not always directly related to water use, and in fact each season is complicated by many other factors including timing of water availability, local temperature and climate during the growth period, and presence of pests and insects. The availability of water thus becomes a way of optimising against these other factors.

As an example, the 2001/02 season had relatively low water availability, but this season had a wide range of weather conditions. It was very dry around planting, which resulted in a small dryland crop. Early season from October to December was cold, but it then remained hot with clear skies producing record yields at the time and helping to explain the relatively high number of bales. Insect pressure was low, which helped reduce production costs, but prices were also low.

Table 14 Water use and Production in the Lower Balonne

Season	Cotton Bales Ginned (St George and Dirranbandi)	Approximate Water Use in the Lower Balonne (GL)	Bales/GL
2007/08	26929	Less than 5000	Unknown
2006/07	35736	5000	7.1
2005/06	195517	53000	3.7
2004/05	287581	50000	5.8
2003/04	105658	353000	0.3
2002/01	35145	35000	1.0
2001/02	170301	10000	17.0
2000/01	345000	175000	2.0
1999/00	365000	173000	2.1
Average	174096.3	106750	1.6

Source: Roth 2010

Note. GL = giga litre

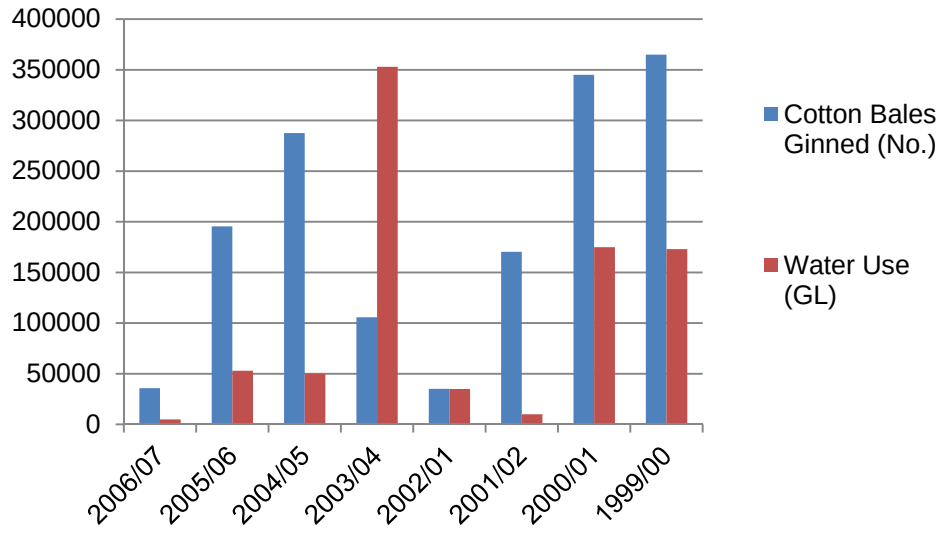

Figure 43 Water Use and Production, Lower Balonne

Implications

The interview responses, coupled with the general comments from businesses, growers and community members indicate that they saw themselves and their community as being adaptive and resilient, being able to 'tighten the belt' and see out difficult periods, then 'bounce back' in good times. Family businesses, i.e. those that could survive without significant turnover, were seen to be an important part of this. The importance of the river running through the town as a physical representation of the community's resilience was also evident.

Farm and non-farm businesses exhibited strategies aimed at retaining staff through difficult periods. The reluctance to lose staff (except when absolutely necessary) means that employment loss due to lack of water availability is non-linear, i.e. there is no direct relationship between declining production, subsequent loss of business and declining employment (although of course that is not to say there is no relationship). The reasons for this include difficulty in attracting new staff when times get better, and the fact that employers know the impact that job loss will have on individuals and the community and

try to avoid it. Most businesses mentioned issues of labour availability, including competition with mining and lack of skilled candidates.

Cotton Businesses in Gunnedah

Similar to St George, a cross section of businesses in the Gunnedah cotton supply chain was interviewed for this study. The cotton supply chain in Gunnedah is similar to that of St George, but many farmers and businesses are more diverse in their operation. The following diagrams give examples of businesses and growers in Gunnedah who are part of the cotton supply chain.

Table 15 Cotton Businesses, Gunnedah

Supply Chain Business	Time Operating in the Area	Importance of Cotton production to Operation	Average Yearly Turnover	Employment
Irrigation Supplies 1	1 to less than 5 years	Important (40-60% of income), service about 50 growers, other activities include dairy and effluent piping.	$2-10 million	6 full time staff, 9 contractors
Supply and Agronomy 1	More than 25 years	Small Contributor (10-40% of income), service about 20 growers, other activities are broad acre cropping and fallow.	$2-10 million	10 full time
Cotton Gin and Marketing 1	15 to 25 years	Crucial (More than 90% of income), about 35 growers serviced. Marketing includes 6 buyers over 1000t and 35-40 smaller buyers of cotton seed.	About $8 million	5 full time
Cotton Gin and Marketing 2	More than 25 years	Crucial (More than 90% of income), about 35 growers serviced.	$2-10 million	70 full time, 100 casual from March-July in the Namoi Valley

Table 16 Growers, Gunnedah

Grower	Time Farming in the Area	Scale of Cotton Production	Other Land Uses	Water Allocation	Best Profit in the Last 5 Years	Employment
Grower 1	25 or more years	506ha (irrigated) at 9.2 bales/ha or 1.6 bales/ML, also 200 ha dryland.	Wheat, canola and cattle	1520ML General Security, 1600 ground water entitlement and 8 Ml high security (2870ML used last season)	Over $1 million	5 full time, 2 casual and 5 contractors
Grower 2	15 to 25 years	282ha at 12bales/ha or 1.9bales/ML	Cattle, wheat, barley, chickpeas, dryland cotton	642ML groundwater entitlement and 2400 unregulated (1700ML used last season)	$500,000-$749,000	2 full time, 2 full time contractors, 7 casual
Grower 3	25 or more years	464ha at 10-12 bales/ha or 3.3 bales/ML	Wheat, barley, canola, corn, sorghum, dryland cotton and faba beans.	1724ML ground water entitlement plus 300-600ML overland flow utilised every year (1400ML used last season)	$750,000 to $1 million	6 full time, 1 part time and 2 casual

Note. ha=hectare; ML=mega litre

Managing Change

The growers interviewed in Gunnedah had more diverse farming operations than those in St George, including cattle and growing other crops such as wheat, barley, canola, faba beans, corn and sorghum. When asked about their management actions in the last five years, the growers interviewed in Gunnedah all indicated that they had changed their irrigated production crop mix and improved the efficiency of their irrigation infrastructure. Two of the growers also indicated that they had increased their irrigated area. The table below summarises some of their comments regarding the recent drought.

Table 17 Managing Change, Growers

	Strategies for Managing Change
Grower 1	During the drought this farm increased non-irrigated cropping, maintained income through off-farm contracting and increased water efficiency, thus leading to an increased area of irrigated production. In better times employment has increased and machinery has been purchased, thus reducing the use of contractors.
Grower 2	During the drought lateral move irrigators were installed to save water. Water saving for next season's cotton crop is also an important strategy and allows some forward selling each year to get a better price.
Grower 3	This farm is planning for reduced water availability over the next five years, but the reduction of water availability is not a major threat because of the certainty of rainfall and groundwater. There was no affect on the business during the recent drought because of the reliability of the area, and the high rotation of crops is for agronomic, marketing and risk management reasons.

Farmers were also asked to predict their actions if water availability (and its impact on cotton related businesses) was decreased or increased by 10, 25 or 50%, respectively. This question was not as well answered as in St George, because the growers saw it as less relevant to their operation; there is much higher water security around Gunnedah because of access to ground water and higher rainfall. The overall results were:

- one farmer indicated that his water availability didn't change because of the reliability of ground water and rainfall on the Liverpool Plains
- one farmer indicated that he would have to reduce labour requirements at a cut of 10% water availability
- one farmer indicated that a 10% cut in water availability would lead to reduced labour requirements, decreased plantings and changed crop mix, while a 25% reduction would lead to him leaving farming and the community.

These answers show the diversity of business operations amongst growers and illustrate the difficulty in generalising the affects of cuts to water availability on the local economy as a whole.

Businesses in the Gunnedah Cotton Supply Chain were asked a similar question to farmers i.e. to predict their actions if cotton related business was decreased or increased by 10, 25 or 50%, respectively. The businesses interviewed were unlikely to take action before their cotton related business was reduced by 50%, and the most likely actions were to seek other business income and reduce staff. For the two ginning companies interviewed, reducing cotton business had a much more direct impact; one indicated that they would reduce staff at a decrease of 10% and one at a decrease of 25%. Both indicated that they would sell business assets and seek other business income at 25% or more reduction in cotton production. Comments by businesses on how they managed the recent drought are summarised below.

Table 18 Managing Change, Businesses

	Strategies for managing Change
Irrigation Supplies 1	Irrigation supplies and infrastructure is a growth area, with growers looking to increase their efficiency all the time. The drought did not lead to a change in business, and it focused attention on water availability.
Supply and Agronomy 1	Business has not noticed a change in cotton production and business practices have not been affected. Diversity of the farming base is an advantage.
Cotton Gin and Marketing 1	Changing cotton production had a direct impact on this gin during the drought, which halved its workforce from 2004 until the upturn in the last few seasons. The gin also used strategies such as reducing work hours and working 5 days instead of 7 to maintain full time staff.
Cotton Gin and Marketing 2	Changing cotton production is managed through decreasing casual staff, dealing in other commodities (for example, grains) and reducing capital expenditure. Plants can also be "moth balled" or closed down for a finite time so that a smaller number of gins are run at full capacity.

Water Use in the Namoi

Keepit and Split Rock dams regulate the Namoi water resource and enable management of general security water supply for irrigation. Publicly owned storages account for more than half of the total water storage in the Namoi Valley, but groundwater accounts for almost half of the water used for irrigation. The Namoi has the highest rate of groundwater use in NSW, but major reforms in groundwater management are currently being implemented to address over allocation. The region also has one of the largest levels of groundwater extraction within the Murray-Darling Basin and uses 15.2% (255 GL/year in 2004/05) of the Murray-Darling Basin groundwater resource.

The table below shows the water entitlement volumes in the Namoi Catchment. It should be noted that the actual amount of water used from each license type varies depending on the conditions of a particular season.

Table 19 Water Entitlements in the Namoi Valley

License Type	Volume (GL)
General Security	240
High Security	4
Supplementary	122
Ground Water	191
Total	557

Source: Murray-Darling Basin Authority 2010

Note. GL=giga litre

Implications

Similar to St George, cotton provides significant income for the economy of Gunnedah. However, interviews with farmers and community members suggest that there is much greater variability in crops grown in the area, and it is also common for cotton to be rotated with wheat. Interviews with farmers suggest that the affects of drought in Gunnedah have been more localised (i.e. felt differently at the individual farm level). Water security for many farmers is high in Gunnedah, due to access to groundwater. It is notable that the farmers interviewed had significantly higher profits than in other areas in the last five years. This is reflected in businesses in Gunnedah not having been affected

significantly by drought and appearing confident in the future of the town. Having said this, cotton gins are directly affected by cotton production and this can have significant impacts on employment in the supply chain.

Citrus and Wine in Waikerie

Several growers and businesses in the citrus and wine industries were interviewed in Waikerie. The compounding factors of recent drought, reduced water allocation, a high Australian dollar and rising costs of production have resulted in a number of very difficult years for producers and associated businesses. The following tables show examples from the supply chain in Waikerie.

Table 20 Growers in Waikerie

Grower	Time Farming in the Area	Scale of Production	Other Land Uses	Water Allocation	Best Profit in the Last 5 Years	Employment
Citrus Grower 1	25 or more years	22ha farmed and irrigated with an average of 25 to 30 t/ha	None	220ML all used	$50,000 to 99,999	0.5 FTE plus contract pickers when required
Citrus Grower 2	5 to 15 Years	60ha of irrigated citrus with between 40 and 60 t/ha depending on quality of the fruit	Other horticulture and some dryland farming	560ML (260ML used in the last season)	$50,000 to 99,999	2 Full time, 2 Part time 3 Casual plus contracting for pickers (up to 30 people per day for about two months)
Grape Grower 1	25 or more years	200ha of irrigated vineyard with average yields of about 25 t/ha	Small scale production of garlic and vegetables	Purchases water as needed, 500ML purchased last season	$250,000 - 500,000	5 Full time plus a $130,000 budget for casual staff as required

Note. ha=hectares; ML=mega litres, t=tonnes

Table 21 Supply Chain Businesses in Waikerie

Supply Chain Business	Time Operating in the Area	Importance of Citrus/ Wine to Operation	Average Yearly Turnover	Employment
Horticultural Contracting 1	5 to 15 Years	Crucial (90% of income or more)	$2million, down by 60% in the last three years	Turnover of about 1200 staff as pickers, mainly backpackers. Currently about 150 people, and could be up to 250 people at any one time.
Citrus Packing and Processing 1	5 to 15 years	Crucial (90% of income or more)	Over $2million	20 full time (52 weeks of the year) Up to 20 Casual (40 Weeks of the year) Up to 30 others (16 weeks of the year)
Irrigation Supplies 1	25 or more years	Important (40-60% of income)	$1-2 million	4 full time 3 part time Ad hoc contracting
Supply and Agronomy 1	5 to 15 years	Crucial (90% of income or more)	Over $2million	3 full time 1 Part time

Managing Change

Growers were asked about their actions in the last five years and for the next five years. In previous years, all three growers had improved their irrigation efficiency and changed their production i.e. the mix of crops and citrus varieties. The only common element of planning for the next five years was that the production mix would change. In general, the growers interviewed in Waikerie were facing difficult questions about viability, brought on by the impact of a high Australian dollar on export markets and uncertainty over water availability into the future. Some of their comments about the recent drought are summarised in the table below.

Table 22 Managing Change, Waikerie Growers

	Strategies for Managing Change
Citrus Grower 1	During drought, this grower reduced income, cut back on water use and used up surplus funds. Recent over supply and low price has meant that picking is much more selective, with an emphasis on premium fruit. Commented that the last few years have felt like it "wasn't worth it."
Citrus Grower 2	The drought had little impact on management, but irrigation efficiency was improved during the drought.
Grape Grower 1	This grower entered the water market to get through the drought. Water was bought when needed to ensure production remained viable.

Farmers were also asked to predict their actions if water availability was decreased or increased by 10, 25 or 50%, respectively. Similar to St George and Gunnedah, decreases of up to 25% were likely to affect decision making on crop mix and management, while large cuts (up to 50%) were more likely to influence decisions on labour and long term business decisions (for example reduced assets or closing entirely). Increased water entitlements usually led to farmers increasing their business operations and assets, but the three interviewed saw this scenario as highly unlikely.

Businesses were asked a similar question i.e. to predict their actions if citrus and/or wine related business was decreased or increased by 10, 25 or 50%, respectively. The businesses interviewed were unlikely to take action before their business was reduced by 25%, and the most likely actions were to seek other business income and reduce staff. For the citrus horticultural contractor interviewed, reducing citrus business had a much more direct impact; they indicated that they would reduce staff at a decrease of 10%. Changes to production had the least impact on the Supply and Agronomy business; only cuts of 50% affected decision-making. Comments by businesses on how they managed the recent drought are summarised below.

Table 23 Managing Change, Waikerie Businesses

	Strategies for managing Change
Irrigation Supplies 1	As citrus and grapes have become less viable, the business has had to manage cash flow problems including offering extended payment terms. The business is diversifying away from horticulture where possible. Full time staff has been reduced, with more use of casual and sub-contractors. Have also reduced hours of some staff by agreement.
Supply and Agronomy 1	The business has not been impacted by changes to citrus and grape viability as yet. Cash flow is being monitored while growers receive lower prices for produce. The business was not impacted by the drought.
Citrus Packing and Processing 1	Change to supply is managed by reducing or increasing the number of casual staff. For example, the business has just reduced down to full time staff only because of low supply. Keeping skilled staff is an issue for the business if it can't offer permanent full time work.
Horticultural Contracting 1	This business manages fluctuations in payment from growers by not replacing staff as they leave. Staff are not fired. The drought has meant that there are less people employed and cash flow is reduced. The business is run from a property with little debt, so it is possible to reduce operations significantly for a number of years and then increase operations again when conditions improve.

Water Use in the Riverland

Irrigators in the Riverland region are entirely supplied by the River Murray. Average yearly water use between the years 2002 and 2009 has been approximately 291GL (of a total available of about 344GL). There has been a large investment, both private and Government, in piped systems and modern metering in the Riverland over the last 40 years; the scope for improvement in irrigation efficiency is very low due to the current high level of efficiency. The extent of the Commonwealth Government buyback has been approximately 27 GL of water to 2008-09 from South Australia's high security entitlement in the Riverland. The Riverland area is underlain by saline groundwater that is too salty for irrigation (Murray-Darling Basin Authority 2010).

Decisions about managing water create substantial challenges for growers. The Murray-Darling Basin Authority (2010) states that:

> "Over the last five years there has been substantial purchase of temporary water from upstream states to assist with the low water allocations, especially in 2008-09 when a finishing allocation of only 18% was available. This followed the 2006-07 season allocations of 60% and the 2007-

08 season of 32%. Difficulty in planning water purchases and in deciding which areas to dry off were caused in 2005-06 where a starting allocation of 80% was reduced to 60%. The low starting allocations of 4% to 2% also made it difficult to plan water purchases or drying off. The ability to buy-in water has generally been perceived to be a good thing, but growers have been unhappy to pay the high prices, especially in 2007-08 when the price of temporary water exceeded $1,000/ML."

Implications

Interviews with growers and community members in Waikerie revealed the hardship of the last decade for both the citrus and grape growers. Both supply chains have had to make significant adaptations to cope with declining terms of trade for growers, including reducing casual and part-time staff. As in other areas, processors and businesses dealing directly with produce were likely to be heavily affected by reduced production, whereas agronomy and general agricultural suppliers were usually more diversified and resilient.

Unlike "cash crop" areas such as St George and Gunnedah, planting fruit trees or vines requires significant long-term investment and planning, and there is less scope for changing crops to suit different environmental conditions. Waikerie also has far less opportunity for improving irrigation efficiency, as it already has highly developed irrigation infrastructure. As explained above, the uncertainty over water regulation has also been a compounding factor in creating difficult conditions for growers.

Study Area Profiles: Concluding Remarks

The 2005 Productivity Commission Research Paper, *Trends in Australian Agriculture* (Productivity Commission 2005), identified a number of important changes facing agricultural communities. These include:

- employment per farm at a national level is trending downwards due to improved productivity and efficiency
- the relative importance of agriculture to the national economy is trending downwards, despite absolute agricultural output having more than doubled in the four decades up to 2003-4
- farms are much fewer and larger than twenty years ago. Production is increasingly concentrated on larger farms
- agriculture has become increasingly export oriented over the last two decades — around two-thirds of production is now exported. Exports have also become more diverse, with less reliance on traditional commodities such as wool and more on processed products such as wine, cheese and seafood

These trends have implications for the economies of St George, Waikerie and Gunnedah, which rely on irrigated agricultural industries and their associated supply chains. In St George and Gunnedah cotton is the primary crop, while in Waikerie citrus and grapes make up most of production. The challenges that these industries face are becoming more and more complex in a global market place, and the towns that rely on them have to adapt as a result.

However, despite knowing these broad trends, it is very difficult to quantify what the affect of changes to the farming sector will be for small communities that rely on agricultural industries. For example, if water availability is reduced in St George, how will this affect employment in the town or through the supply chain? What if water allocations are reduced but yields remain high due to other factors? The case studies of farm businesses in this study have confirmed that the relationship between production, profitability and water availability is highly complex and non-linear. It depends on many factors including the timing of the water and the ability of the farmer to employ opportunistic cropping,

severity of pests, localised climatic conditions, management decisions and the ongoing financial position of the grower. This means that the flow-on effects to on-farm employment and economic downturn are difficult to predict. However, if we take cotton as an example, in the case of the cotton gins there is a clear impact on employment, which is directly related to the amount of cotton available in any one season. The affects are thus varied across the supply chain and elasticity is a key feature of the interactions within it. The next section examines modelling scenarios for employment and water availability in the study areas.

Future scenarios

Economic adaptation

It is clear from the profiles of the three study areas that each has been through major changes in the last 100 years. Technological improvements in cropping and water use have brought possibilities of new crops to each of the areas, and this has broadened the economic base of agriculture. While technological changes and economies of scale have reduced the need for labour in agriculture, and hence reduced the most direct flow-on from farming to the rest of the local economy in these areas, the need for skilled labour has increased – just at a time when the skills needed are becoming harder to secure.

Economic sustainability is all about adaptation, about the abilities of communities, their business owners and staff to keep adapting their activities to stay ahead of the local and external forces that drive changes in the local economy. While each of the three study areas has demonstrated great capacity to adapt in the past, a key question for each community is how to prepare for the changes ahead.

Agriculture is the foundation of each of the study areas, and the familiar drivers of weather, production, prices and competition will be overlaid by prospects over the next few years of reductions to LTCE (long term cap equivalent) or Sustainable Diversion Limits (from the new Basin Plan). While there is currently plenty of water in the Murray-Darling system, if the draft Basin Plan is adopted it will mean that the next El Nino cycle may well see reductions in water available for agriculture throughout the basin.

Key trends in agriculture in the three areas

The key trends in agriculture that have the most impact on the local economies in the case study areas are:

1. grower numbers
2. grower activity and productivity
3. grower local spending and employment.

Grower numbers

The number of cotton growers in St George numbers fairly stable in the low 40s since the peak of around 50 in 2003.

The number of cotton growers in the Upper Namoi has also been in the low 40s since a high of 58 in 2004 (and a previous high of 140 in 2001).

The number of citrus growers in Waikerie has been declining slowly for many years, partly through aggregation and partly as irrigated land is being removed from productive use.

Grower activity and productivity

Cotton plantings vary from year to year depending on expectations of water availability and price, weather and cotton prices, on grower business practices and costs. Through the early 2000s areas planted under cotton in the St George and the Upper Namoi regions ranged from 3,500 to 31,000 hectares (see Figure 44).

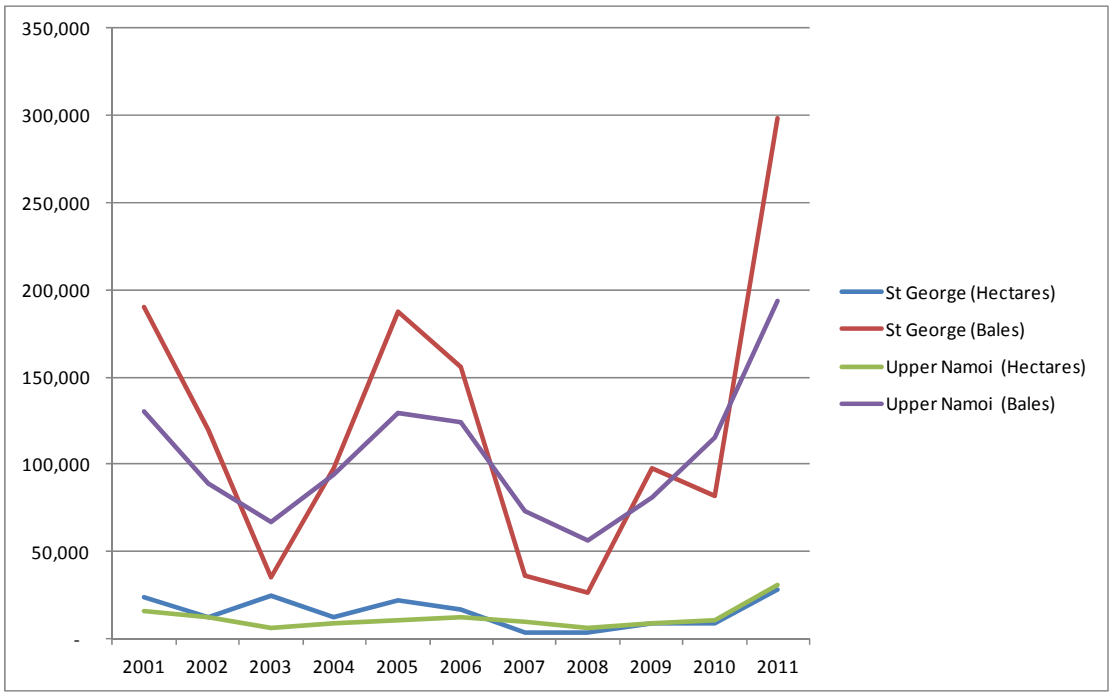

Figure 44 Cotton planting area and harvest

Source: Roth 2010, The Australian Cottongrower 2009, 2010, 2011

The chart shows that the area planted in St George was more variable than in the Upper Namoi, with consequent larger variations in the number of bales harvested as well. The overall picture shows the extent of annual variability in planting and yield, with a variance from peak to trough in St George of over 6-fold, and over 4-fold in the Upper Namoi. These variances demonstrate the extent of the annual variability in activity which cotton growers and cotton communities have to manage.

Underneath this variability is a clear trend showing increasing yield per hectare, especially for irrigated cotton. In St George and the Upper Namoi (irrigated) yields increased from around 8 bales per ha in 2001 to around 10 bales/ha in 2011.

Long term average water use nationally is around 9.5 Megalitres per ha, which is equivalent to some 1 Megalitre per bale. Precise water use figures for cotton are difficult to compare across regions and years due to the impact of climate (precipitation and evaporation) and the consequent level of need for irrigation. Many of those interviewed for this project reported water productivity at 2-3 bales/Ml, well above the national benchmark.

The Riverland has seen over a quarter of citrus growers leave the industry, though the number of trees appears to be increasing slowly as the remaining growers consolidate and search for improved efficiencies. Water use efficiency improved significantly through the drought years with under-tree drip irrigation now commonplace – technological progress which required further capital investment. This additional investment came in a period when incomes were been low (Riverland Weekly, and has pushed the aggregation of farms – with those continuing tending to get larger, while owners of smaller holdings tending to either sell up or specialise in high value varieties.

Grower local spending and employment

The direct impact of production on the local economies depends on the areas planted and the yield. Analysis of grower financial data (Cotton CRC 2006) shows that cotton operating costs increased steadily over the decade 1997 – 2006 from around $2,500/ha to around $3,300/ha. More detailed analysis of these costs shows that the component of this spent locally was around $2,600/ha in 2006 – on inputs like machinery repairs and maintenance, motor vehicles, seed and wages. Over time, the local spend has increased slowly with inflation from around $2,100/ha to $2,600/ha, while decreasing in its share of operating costs from 86% to 79%. This trend indicates that the direct local spend from growers is decreasing, irrespective of planting and harvest levels.

The share of employee wages in costs has been steady at around 10% of operating costs, and there was more money spent on wages (per ha) in drought years 2003 and 2004 than in other years indicating sustained levels of on-farm activity even during these very tough years.

Overall, cotton farms employ one person per 180ha under cotton, with the top 20% of cotton growers employing fewer people (290ha/permanent employee per ha).

Cotton prices are another important determinant of the impact of cotton production on local communities. The cotton price in Australia had generally been trending down over the last decade before turning up in 2008 and then showing a major spike in 2011 when it averaged $840/bale.

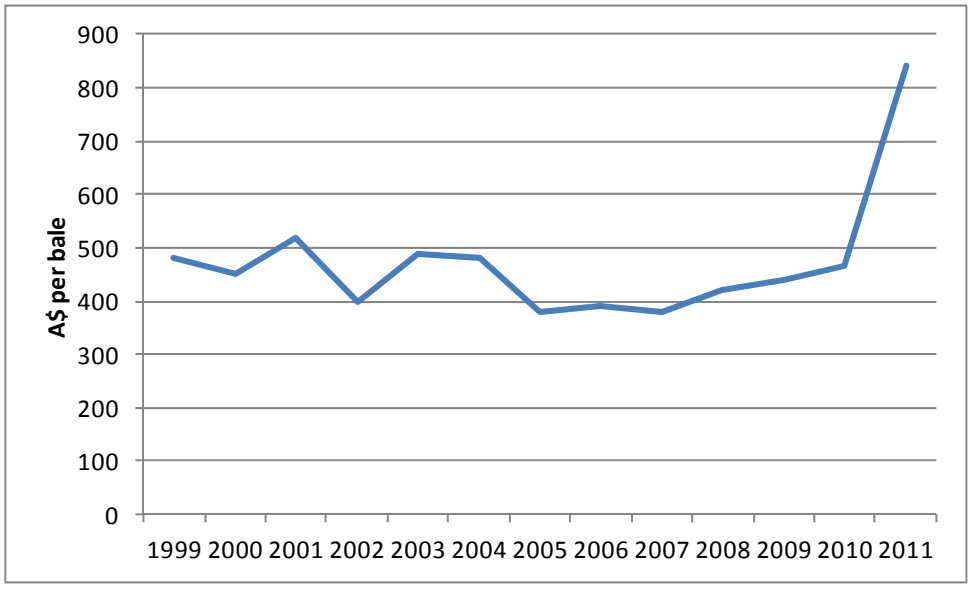

Figure 45 Cotton price trend

Source: The Australian Cottongrower 2011

Once the capital investment in citrus or grapes has been made, the largest production cost is labour, accounting for around half total cost of production. Freight is another significant cost, alongside water purchases (in a typical year), fertilizers and pest control (Citrus Growers of South Australia 2001).

Average citrus and grape prices have generally declined over the 2001-09 period, with grape prices continuing that trend in the last few years while citrus prices have increased slightly.

Wider impacts

Agriculture is the foundation of each of the three study areas, and local farmers will no doubt continue to adapt their practices. To understand how these future adaptations will impact on their local economies, it is important to understand how agriculture is linked to the wider local economy.

As the profiles showed, measured in terms of employment or business numbers, agriculture in all three communities takes up a high percentage of total activity. But how much difference does a change in agricultural activity make to the local economy?

A 2005 report into the impacts of drought 'beyond the farm gate' on non-farm businesses and communities (Houghton 2005) identified four types of businesses in a rural or regional community with quite different linkages to (and dependencies on) agriculture (Figure 46).

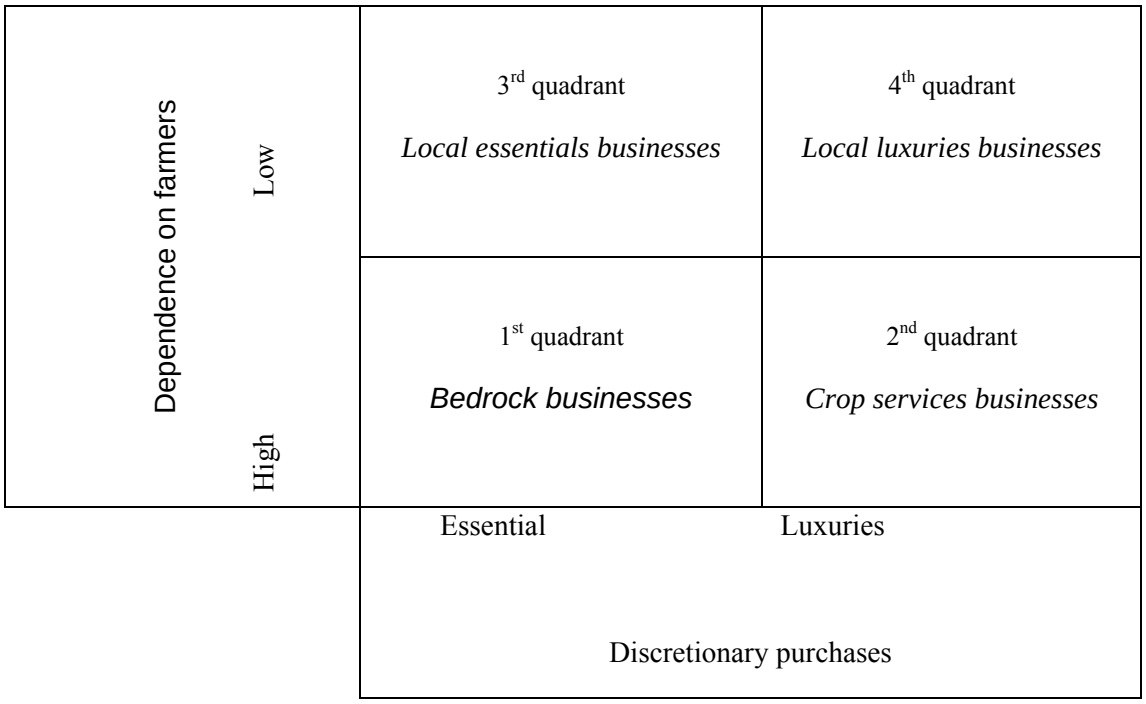

Figure 46 A Model of Primary Production Impacts on Small Business

Source: Houghton 2005

This model proposes that the immediate sphere of influence of the farm sector is strongest on those businesses with direct supply chain links (first and second quadrants), and is weakest for businesses that supply the goods and services that keep the community going (3rd quadrant).

The 'Bedrock Businesses' and those that rely on farmers as essential customers, and they purchase goods/services are purchased even when production levels are low. Typical examples are the stock and station 'seed, feed & weed' suppliers, machinery dealers and farm maintenance providers.

The 'Rural Support Businesses' are those that also rely on farmers as essential customers, but there is some discretion in what is purchased and when, and purchases are closely aligned to production. Typical examples are crop purchase brokers / wholesalers, farm-related transport, motor vehicles, hardware and plumbing/drainage suppliers.

For the 'Local Essentials Businesses' farmers and farming families are important customers, but their significance is diluted as these businesses draw customers from other parts of the community as well. Typical examples of these 'essentials' are businesses that sell food, health care, essential services, news and local paper (but not magazines or books), some (work) clothes, real estate.

Farmers form just part of the customer base for the 'Local Luxuries Businesses', and the goods and services sold are seen more as 'luxuries' that can be done without when cash is tight. Typical examples are gift shop, florist, hairdresser, non-work clothes, travel services.

Interviews conducted for the 'beyond the farm gate' research showed that the many farmers continued purchasing their core goods and services during the drought, meaning that while turnover in the bedrock businesses was lower than in good years, they were still busy. The businesses most affected by the drought were those that relied on decent production levels, and with production way down these rural support businesses had very little work. Without crops to harvest or transport, or wool to aggregate and sell there was no demand for these particular businesses. The research also found that with on-farm incomes falling very low, the Exceptional Circumstances payments for farming families had a significant impact in ensuring there was enough local spending to enable people to stay in the district, keep shopping locally and keep the local 'essential services' businesses going.

The different responses to low crop levels between quadrant 1 and quadrant 2 businesses was also seen in the interviews done in the three case study areas for this research.

Farmers maintain the primary/fixed costs associated with producing:

> "During the drought we grew whatever cotton we had the water to grow." (Cotton Famer St George)
>
> "In the irrigation area our fixed costs are quite high . . . ." (Cotton Famer St George)
>
> "The biggest impact on the bottom line is cotton production . . . your first and foremost focus is to have production." (Cotton Famer St George)
>
> "At this point in time there as been no real impact [from changing citrus/wine production levels]. We need to watch cash flow as growers suffer downturn . . . from lower pricing for produce." (Comment from Agronomist Supplier in Waikerie, reflecting that business is maintained despite poor position of many growers)

But, secondary costs are reduced, affecting many businesses to some degree:

> "The St George irrigation area . . . is made up of predominantly family farming operations and without the St George irrigation area, St George businesses would not have had the core, the critical mass to be able to stay in town . . . the critical mass of demand for their services and their goods is being maintained by . . . the farmers." (Cotton Famer St George)
>
> "In a dry year we don't replace any machinery at all." (Cotton Famer St George)

Reflected in another comment by machinery business:

> "We were greatly impacted [during the drought period]."

The largest employment cuts during difficult periods were in businesses that processed or relied on primary product, for example gins and the citrus juicers. For example, a citrus packer in Waikerie has:

> " … fixed assets and overheads with reduced raw material. Three packing houses in the area have gone into receivership."

Horticultural contractor Waikerie:

> "Any fluctuation in fruit has an adverse impact, and payments from growers will slow down. "

Usually the businesses not directly reliant on primary production had some diversification and worked to find other income:

> "We're diversifying away from horticulture wherever possible, for example into the seafood industry." (Irrigation Supplies Waikerie)

The modelling presented later in this report on the three study areas recognises the importance of these distinctions in preparing truly local economic models, and focuses on businesses in the quadrants 1 and 2, those that are tied most closely to the agriculture supply chain.

Wee Waa Case Study

Further insight into the links between agriculture and the local economy are found in three studies done by the Cotton Communities CRC on the NSW Namoi Valley town of Wee Waa[1]. Studies in 2004, 2007 and 2012 researched the impacts of drought and highly variable agricultural production on the local economy and the community.

The surveys covered a mix of main street and other businesses, and 25 responses were received in 2007. There were around 230 non-farm businesses in the Wee Waa postcode in 2007. Most of these (138) had no staff (ie they were owner operated) and many of these would have operated from home and probably not reached by the 'drop off' surveys. In 2007 Wee Waa had around 90 employing businesses – 51 of these employing less than 5 people. So the 25 respondents represented a good part of the non-farm employers in the town in 2007 – though did not represent the non-employers well.

The studies found that the total turnover of businesses surveyed in 2004 and 2007 fell to around half 2001 levels, and so some 60% had shed staff (both permanent and casual staff), with staff numbers dropping to around half 2001 levels in those businesses that had shed staff. Many of the businesses surveyed were in quadrant 1 and 2, with almost all (95%) saying they had a 60% or greater reliance on a healthy agricultural sector.

Another survey was done in 2012 to understand how businesses were fairing in the post-drought period. By 2012 turnover had risen again in most of those who completed the survey, though employment numbers were still below 2004 levels. The main features of the 2012 survey were the lag identified in employment relative to turnover growth (which mirrors the lag going into the drought when employment stayed higher than expected given the falls in turnover), and that 38% of the respondent businesses had new owners since 2007.

The Wee Waa studies confirm the importance of the link between positioning the supply chain and impact of drought – while overall turnover halved amongst those surveyed through to 2007, 40% did not shed staff. The impact on staff was clearly concentrated in a few businesses – probably those in quadrant 1. And coming out of the drought, turnover rose faster than employment, again illustrating the 'stickiness' of employment during fluctuating turnover cycles.

This research confirms that in a small community the impact of reduced agricultural activity and production is significant in many parts of the local economy, but that the links are neither linear, nor symmetrical across the boundary of the external shock.

Local supply chains in each area

Schematic representations of the main agricultural supply chains in the three study areas were shown earlier in this report.

For each area, the first of two main drivers is the area to be planted/actively farmed each season. This farm-level decision has significant implications for the extent of local spending by growers. The second driver is the quality of the growing season and the consequent yield, with its implications for the quadrant 1 businesses and their activity levels. Employment from processing/handling businesses has some impact on the surrounding local economies.

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[1] *The Impact of Drought on Small Business – A Pilot Study on Wee Waa*, Cotton Catchment Communities CRC, 2004, 2007, 2102

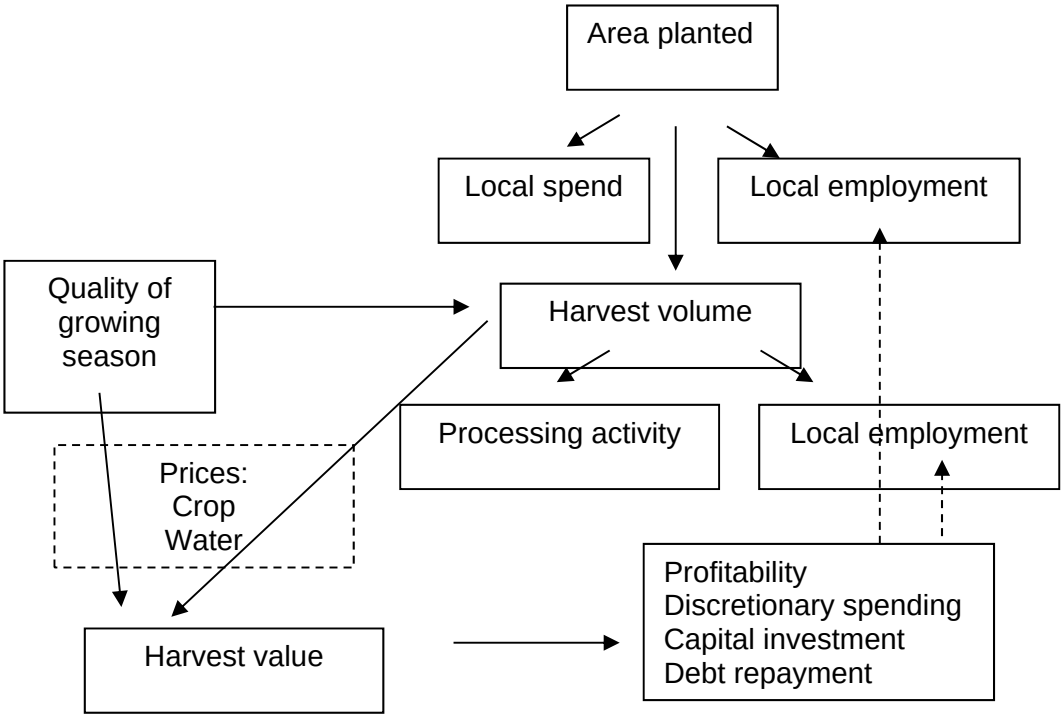


Figure 47 Local economic flows

The schematic above is based on the following links:

- area planted determines local spend and local employment
- quantity of harvest determines ginning/processing activity levels and employment
- value of harvest determines debt repayment, capital investment and discretionary spending in the community
- harvest value is offset by water availability and cost influences on aggregate operating costs, and therefore profitability.

One of the key drivers is the area of land planted (in the case of cotton) or actively farmed and picked (in the cases of citrus and grapes). Our interviews asked growers what influenced their planting/farming decision, and water availability was nominated as the main determinant, followed by expectations of price.

The main influence is water availability (i.e. the allocation coming up) and the predictions for whole-season rainfall, while the anticipated availability of irrigation water is the limiting factor in areas like St George and Waikerie. Growers make a fairly high risk decision on the area that they think they can plant with the water they think/know they will have available, and then seasonal variation can give benefits in terms of yields from the area planted and potential cost reductions through reduced water purchase. Hence with all the rain this 2012 season, the area planted is at a maximum, even though the floods will mean that the yield may be below average.

Growers weigh up the cost of planting but generally seem willing to take fairly substantial risks if they think they had the chance of a good season and plenty of water, because the return (particularly for cotton) will be good. Water allocations (based on general/high security purchases) are set by State regulatory bodies (percentage of entitlement actually offered) against entitlements. Cotton growers generally seem inclined towards more risky rather than less risky planting/farming practices as cotton

is seen as a cash crop, and while there are real costs to getting the seed sown, grown and to harvest, the value of any amount of crop that is harvested is high enough to help cover the costs of growing and contribute to the costs of farm infrastructure. The situation is similar for citrus and grape growers as, while they don't have to face the annual decision to plant or not, they do need to cover year-round maintenance costs of trees/vines and infrastructure, and therefore also tend to be bullish on harvest expectations.

The biggest external risk for growers is that water will not be available. The detailed farm figures indicated that for cotton farmers, in the past this resulted in increased costs due to water purchases and higher labour costs, which reduced profit margins. For citrus and grape growers the need to buy scarce water also tends to push up operating costs. For all three crops, however, the share of water purchase in operational costs is between 2% and 4% in non-drought years for cotton and 10% for citrus. This rises to 10% for cotton and 20% for citrus in drought years. In comparison, labour costs in cotton run at around 10-11% of total operating costs, and at 40-50% in citrus and grapes.

The chart below uses national data to show the expenditure per hectare on water and wages (excluding owners wages) for cotton farmers from 1997 to 2006. The chart shows a steady increase in the cost of wages (per hectare of crop), with a spike in water costs per hectare (some $200/ha more than in better years) during the drought years 2003 and 2004. The chart also shows an increase in the cost of labour in those years, indicating that growers invested in *additional* efforts to manage their crops through the dry years. The wages bill in the drought years was 1.3 times that of the wages bill across the non-drought years.

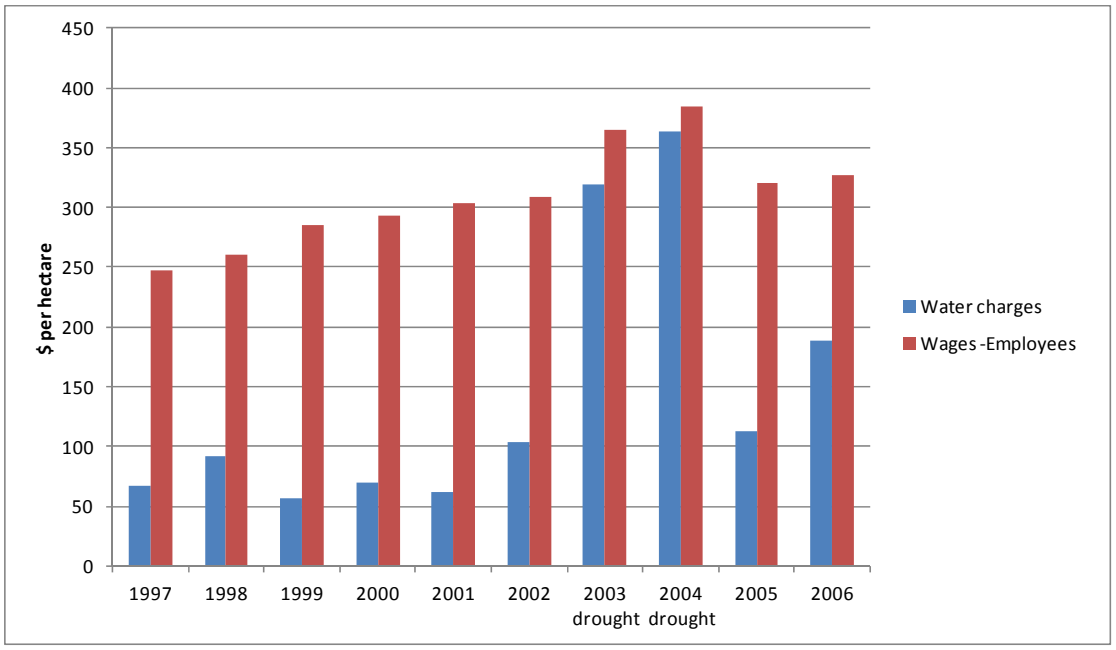


Figure 48 Cotton grower expenditure per hectare on employees and water

Source: Cotton CRC 2006

Adaptation

A weakness with the near linear approach in the schematic above is that it does not take account of the adaptation that players in the chain make all through the growing season. The interviews from all three study areas demonstrated how growers and downstream businesses alike will take action all through the season in anticipation of higher (or lower) activity levels. And with the 4-fold and 6-fold year-to-year peak to trough variances demonstrated in Figure 44, the growers and businesses in the case study areas are very well experienced in adapting to changing circumstances.

Grower adaptation:

The interviews showed that growers are used to managing the wide fluctuations in area planted and the value of their harvest. Feedback was consistent across cotton, citrus and grape growers interviewed that a reduction of water availability of 10% or 20% is well within their normal business parameters and they will use immediately available tools to vary the mix of farm operations and scale of planting to minimise any negative impacts on their farm businesses by reducing costs and widening income streams where possible. Adaptive measures taken were:

- increase borrowings
- sell business assets
- seek other business income
- reduce labour (and defer non-essential spending)
- decrease plantings
- change crop mix – minimal area of cotton, with balance to crops requiring less water

Further reductions in water availability, though, have much deeper effects on operations. A 50% reduction in water availability means that growers will review the viability of the farm in that season and will consider selling assets, finding other income or employment, leaving farming and leaving the community.

Business adaptation

The interviews showed that quadrant 1 and 2 businesses are also used to harvest variability. Business owners report that they take some action if activity levels drop by up to 25%, but that the main actions involve monitoring and reducing costs by, for example:

- scaling back purchasing
- scaling back casual staff but maintaining 'permanent' staff.

As with growers, though, if activity levels drop by 50% then more drastic action follows such as active diversification into other business income, overall reductions in staff and contractors, and reduced spending on other operating costs. Only those businesses directly handling farm products react faster – with citrus processors saying they will start to lay off casual staff with a 10% fall in activity, and cotton gins adjusting their casual employment levels to suit the scale of flow of cotton bales.

It is clear that in modelling local economic activity in these rural study areas, the main players in the supply chains are experienced in handling variability in agricultural activity levels, and that there is not a simple, linear relationship between planting, harvest and local flow-on spending. In particular, it is not accurate to predict flow-on spending by growers, or employment levels on farms or processing businesses, as a fixed proportion of areas under crop across a wide range of cropping areas. There is a tipping point for grower and business adaptation between 25% and 50% reductions in water availability, with practices for both groups changing significantly across this boundary.

Modelling the future

An important aim of the overall interdisciplinary project into which this economic component fits is to help communities understand what the future holds for them – especially under some different scenarios.

Economic modelling has been likened to driving forwards while looking only in the rear vision mirror, as it can only use historical data, and that this can be a poor guide to what will happen in the future. Economic forecasting (modelling with more courageous assumptions) has been described as an activity invented to make fortune telling look respectable. These light-hearted definitions are based on the poor record that economic analysis has in predicting the future, especially in the many cases where the future does not continue a trend visible in the recent past. Economic models are based on long run relationships and ratios, and on some strong underlying assumptions that constrain human behaviour and decision –making. Were these constraints removed, it is often perceived that modelling would be too inconclusive to be useful.

Usual approaches

The regional input output approach is the most common way of building a predictive model of how a regional economy will react to external shocks. Unfortunately, while input output models have been used effectively at the national scale, at the regional and local scale they cannot reflect enough of the local specialisations, strengths and weaknesses to be reliable. A regional-scale input-output approach known as Generating Regional Input-output Tables (GRIT) is in common use, and a study for the Cotton Catchment Communities CRC in 2008 (Powell & Chalmers 2008) noted a series of limitations (comments in **bold**):

1. a linearity assumption implies that any change has proportionate effects throughout the economy so that there are no substitutions among inputs and products. **Implication – fixed supply chains from paddock to export mean that the model cannot respond to adaptation and seasonal variation**

2. a set of homogeneity assumptions mean that all of the entities (eg farms) in the specified sectors are the same in terms of production technology, products produced, goods consumed, etc. **Implication – model eliminates adaptation amongst growers and between growers**

3. there is no consideration of market effects in the input-output model and all results are based on real changes in production of goods and services. **Implication – models allows for no feedback between price signals (and more importantly for growers price expectations and forecasts) and cropping behaviour**

These limitations reduce the effectiveness of these models in forecasting the evolution of local economies, and in estimating the impacts of the changes that are affecting them.

Regional input-output models are often used to quantify the flow-on effects through a regional economy of an external 'shock' such as a change in commodity prices, labour costs or energy prices. The flow-on effects are estimated by considering the 'multipliers' through the regional economy, multipliers which are part of the regional input-output model and which link the inputs into an industry from other industries, and the output from an industry into others. While still widely used, these multipliers are highly misleading and are no longer published by the ABS as they have been used inappropriately:

> "While Input-Output multipliers may be useful as summary statistics to assist in understanding the degree to which an industry is integrated into the economy, their inherent shortcomings make them inappropriate for economic impact analysis. These shortcomings mean that Input-Output multipliers are likely to significantly over-state the impacts of projects or events." (Australian Bureau of Statistics 2009).

The most comprehensive and locally-driven modelling identified was done in 2003 by CARE for the Department of Transport and Regional Services (Institute for Rural Futures 2003). This work recognised the limitations of input-output modelling and sought to take account of local circumstances and variations (from national productivity measures) by developing a series of farm-level production functions which reflected farming practice in the study area. The outputs of these production functions under different water availability scenarios therefore reflected what growers were saying about how they would adapt their practices. And the quantitative outputs were then fed into the regional input-out model. This approach enabled the input-output modelling to take better account of local and regional farming practices, and still model the flow-on effects of changes in these across the regional economy.

This combined approach found that:

> "The individual results do vary substantially from farm to farm because they do reflect the individual responses of those landowners. Those responses vary from being marginal adjustments to crop areas to radical restructuring from cropping to livestock production supported by intensive feeding of fodder and grain produced from irrigation. …
>
> The flexibility in adapting to the WSP will vary considerably from farm to farm depending on their circumstances such as the land use systems, debt levels, farm size and the arrangements for use of machinery and labour." (p66)

The analysis found an anticipated impact of the Water Sharing Plan cuts to be in the order of 5-10% of lost Gross Value of Agricultural Production in the catchment over 20 years. But the study also noted that:

> "These impacts are unlikely to be apparent in reality. Implementation of the WSP will not now commence until the 2004-05 irrigation season and will be confounded by changes in prices, recovery from the drought and the macroeconomic trends in the economy and regions. The impacts will be part of that set of factors that impede this region from sharing in and contributing to the growth of the National economy.
>
> The impacts would primarily affect farm and agricultural services employees. Those with high skills are likely to be mobile and would find alternative employment in another industry or place. The less skilled are likely to remain with limited job prospects and with limited capacity to move elsewhere. They may become dependent on social welfare support until suitable alternate employment eventuates.
>
> Some irrigators are likely to have businesses that are now unable to service debt or to earn sufficient income to support the owners. This will lead to some farm rationalisation with fewer farms. The larger operators will employ less labour and purchased services." (p 98)

The implication for economic adaptation is that water cuts alone would impact differently on different farms, depending on their risk profiles, current level of investment in water efficient infrastructure, and crop mix and potential. And while the modelling was able to isolate the influence of the proposed water cuts, the proposed cuts were but one of many factors set to influence farm productivity and regional economies over the 20 year modelling horizon.

Local production systems approach

The alternative to scaling down a national economic model is to build up a local economic model of the agricultural production system. While this approach is likely to be weak in its ability to track the flow-on effects and links between all the different parts of the economy (the strength of input-output modelling) it gives a much more accurate picture of the scale of activities along the local agricultural supply chain, and their responses to increased or decreased activity (the weakness of input-output modelling).

The local production systems approach set out here is based on the collection of data from local growers, handlers and value-adders on their scale of operations (including employment), the factors that determine this, and the main upstream and downstream links in the supply chain.

For each of the three study areas a series of interviews with farms and businesses in the supply chain were used to gather this information. While it would be ideal to interview all the farmers and businesses in these supply chains, to gather current and historical activity data, the cost of this would be prohibitive so the approach here uses a sample of interviews coupled with a picture of the scale of the whole supply chain for the area drawn from ABS sources. Two sources are used to round out the picture:

- the latest Census – for its details on the number of people employed in industry sub-sectors along the supply chain in the local areas
- the Australian Business Register for its detailed counts of business in industries and industry sub-sectors in the local areas.

The supply chain maps that are revealed by this approach are set out in the three schematics below.

Updates on local business mix and employment patterns will be available later in 2012. New employment data will come from the release of the 2011 Census data. And new business counts data will be available in late April when the ABS releases time-series data of business counts for Statistical Local Areas for the period 2007-2011. This data will enable more detailed analysis of the extent to which the local economies in each of the study areas has changed in the post-drought period.

In the next section of this report local productions systems models are used as the basis for estimating the impact on the local economies of changes in farm production. The estimated impacts are based on the historical experiences of those businesses interviewed over the last decade, a period which covers both low-production drought years and some high production years.

Is the past a good guide to the future? Past experience shows the real changes that have been brought to the production system, but there is always the possibility that future external challenges will be handled differently. All modelling is quite sensitive to the assumptions underlying the relationships and expected behavioural changes. The next step of sophistication in this local production systems approach is to integrate the findings from the community adaptation work which has also been undertaken as part of this overall project. The community adaptation surveys will shed more light on the 'tipping points' within communities, and on the changes in behaviour that occur when these thresholds are crossed. These tipping points in the community sense mirror the tipping points already flagged by businesses in the supply chain – where their reactions to a large (50%+) loss of water availability will be quite different to their reactions to a small (less than 25%) loss of water availability.

The community adaptation work also draws in aspects of the underlying flows of people (residents and workers) in and out of the study areas. These flows continue in good times and bad times, and do not simply reflect the departure of displaced workers during drought. Much of the community adaptation work confirms that employers tend not to let staff go, and community members tend to defer leaving the area for as long as possible. The attachment to place held by both residents and workers serves to internalise the impact of bad seasons – slowing the pace of real adaptation by making movement 'sticky', and also slowing the pace of recovery as financial debts and low levels of capital investment take several good seasons to recover from.

The links along the along the main agricultural supply chains in the three study areas are shown below (see Figures 49 -50)

Figure 49The scale of operations at each point along the supply chain is shown in terms of the typical number of businesses engaged, and the range of employees. The range covers both annual seasonal variations in employment and variations across good and bad years.

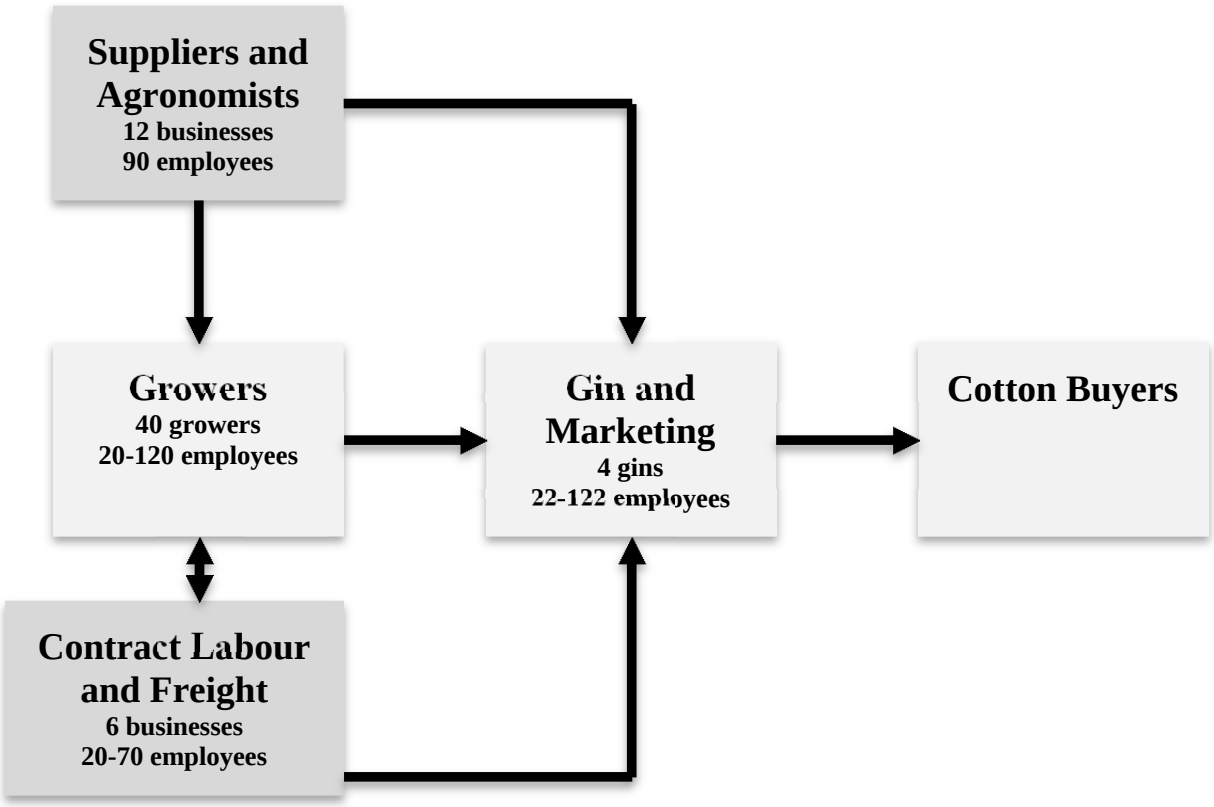


Figure 49 St George cotton supply chain

St George Cotton Supply Chain Businesses

Contract Labour
- *Jones Air* (15 full time and 6 casual employees, over $2 mil turnover)
- *Private contracting for machinery and services* (example: 2 full time and 1 part time employees, turnover of $750,000 to $1mill)
- *Balonne Airwork*

Gin and Marketing
- *Queensland Cotton* (4 gins in the area with 22 full time and about 100 casual during peak season)

Cotton Growers
- *Approximately 40 growers in the St George area*

Suppliers and Agronomists
- *Vanderfield Machinery* (18 full time employees, over $2 mil turnover)
- *Total Ag* (3 full time and 1 part time employees, over $2 mil turnover)
- *Agnvet* (5 full time staff, turnover around $30 mil)
- *Elders* (7 full time and 2 casual employees, over $2 mil turnover)
- *Cotton Growers Services*
- *Landmark (Also rural real estate)*
- *Street Ag Services*
- *Hasslem Ag*
- *Mulholland Ag Consulting*
- *St George Machinery*
- *Farmers who contract machinery and services*
- *EA Bowman Tractor and Truck Repairs*

Figure 50 St George cotton supply chain businesses

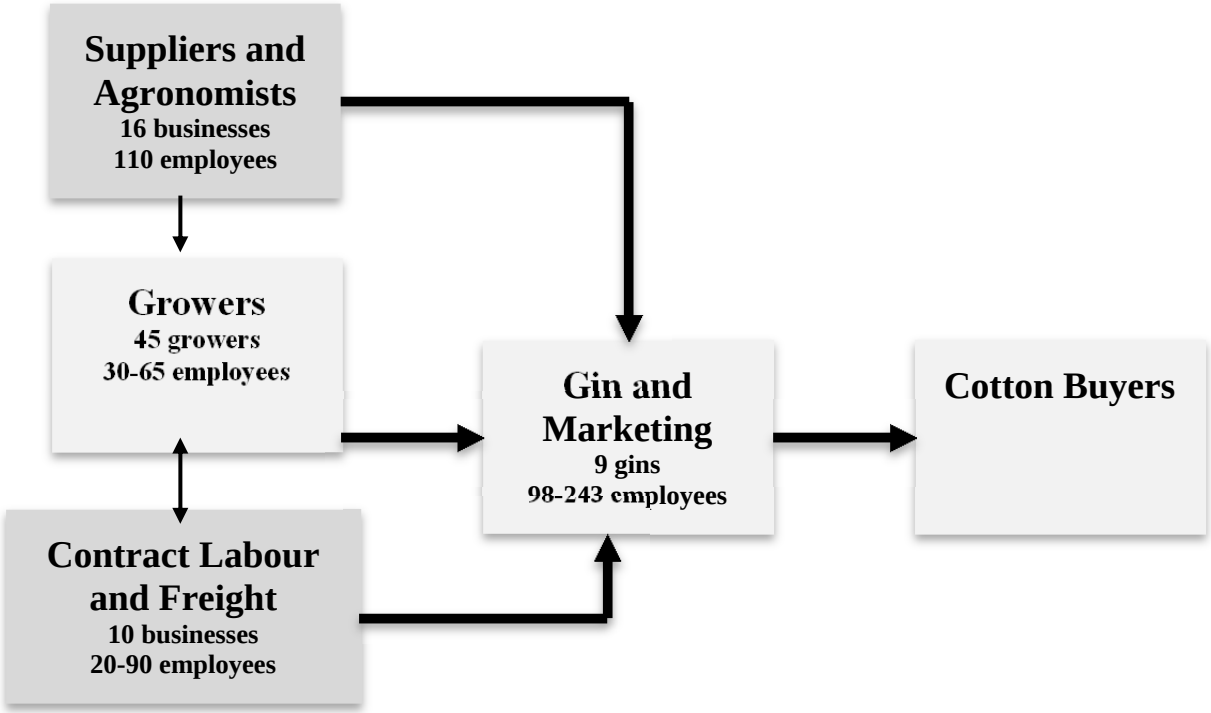


Figure 51 Gunnedah cotton supply chain

Contract Labour
- *Lauravon Contractors*
- *Tony Sims Contract Harvesting*
- *Kennedy Air Ag*
- *Scales Bros Contracting*
- *Farmers who contract services and machinery*
- *Namoi Spraying Service*
- *Middlebrook Air Operations*
- *Beattie Ag Spraying*

Gin and Marketing
- *Namoi Cotton* (6 gins in the area, 70 full time employees and up to 100 casuals in peak season)
- *Carroll Gin* (1 gin in the area, 9 full time employees and about 15 casual at peak, about $8 mil turnover)
- *Austcott* (2 gins in the area)

Cotton Growers
- *Approximately 45 growers in the Upper Namoi*

Suppliers and Agronomists
- *Pivot Irrigation and Pumping* (6 full time employees and 9 contractors, turnover of $2-10 mil)
- *Pursehouse Rural* (10 full time employees, turnover of $2-10 mil)
- *Cotton Growers Services*
- *Elders (also rural real estate)*
- *Landmark (Also rural real estate)*
- *Agronomic Business Solutions*
- *Hunt Ag Solutions*
- *Farm Welding Services*
- *DMI Engineering*
- *Gunnedah Light Engineering*
- *Goodwin Kenny Machinery*
- *Cornish's Machinery*
- *Gunnedah Farm Equipment*
- *Gunnedah Industries*
- *Guest I W Trailer Sales*
- *NFS Agribusiness*

Figure 52 Gunnedah cotton supply chain businesses

Figure 53 Waikerie citrus supply chain

Citrus Packing and Processing
- *Nippy's Waikerie Producers* (20 full time staff with up to 50 casual and part time during peak periods, over $2 mil turnover)
- *Crusta Fruit Juices*

Wine Producers
- *Boar's Rock Winery*
- *Banrock Station*
- *Kingston Estate*
- *Mirabella Winery*

Growers
- *Approximately 500 citrus growers in the Riverland in 2008*
- *Approximately 1100 grape growers in the Riverland in 2011, and according to the ABS Census, there were 214 grape growers in Loxton-Waikerie shire in 2006.*

Suppliers and Agronomists
- *Agribusiness Supplies* (3 full time and 1 part time employees, over $2 mil turnover)
- *AgriTech Irrigation Enterprises* (4 full time and 3 part time employees plus contracting, $1-2 mil turnover)
- *Prime Commerce Agribusiness*
- *Sturt Highway Machinery*
- *BMS Ag and Construction*
- *Elders*
- *McKay's Auto and Ag Centre*
- *Roy Mac Irrigation*
- *Richard Hall Engineering*

Contract Labour
- *Renmark Vineyard Contractors*
- *Farmers who contract services*
- *I. Gent Horticultural Contracting*

(Turnover of approximately 1200 staff as pickers per year with up to 250 working at any one time, turnover of about $2 mil)

Figure 54 Waikerie citrus supply chain businesses

Information provided in the interviews and from local grower groups has shown the extent of variations in planting and harvest (and to a much lesser extent yield) over the last decade. The level of variation in local employment has generally been less than the variations in planting and harvest, as growers and businesses have sought to keep their long-term staff employed, and have continued to use casual staff as the adjustment factor.

Three Future Scenarios

A key question underlying this whole project is to what extent the study communities will be able to adapt to changes in water availability in future.

While water is certainly an important external factor, it is important to note that each region has seen significant local economic change in the last 30 years from other factors such as:

- rapid growth in cotton planting since the 1980s
- shifts in global citrus markets
- aggregation of farms to capture economies of scale
- smarter technologies that enable even greater efficiencies on larger farms.

These factors are longer-run and generally less dramatic than a sudden flood or prolonged drought, but they are nonetheless causing major changes in both farm business practice and local economies. Nevertheless, the scenarios here are around water availability.

From an economic point of view, water is but one of many inputs into a farm business, and it should be possible to model the impact of changing water prices on water consumption and productivity. This has proved a challenge, however, and unfortunately it is not yet possible to develop robust models of farm production functions – and in particular of farm production functions that include water use.

A paper on this topic presented to the AARES Conference in 2011 (Hughes 2011) noted that:

> "However, at this stage the results display a lack of robustness, with estimated marginal product curves highly sensitive to changes in model specification and estimation techniques".

The variability of water use (rainfall versus private bores versus purchased irrigation water) and the substitution between them means that multi-season long run data is required to inform this type of modelling. The consequence of this gap for this project is that the scenarios set out here are based on widely-spaced options of water availability, recognising that smaller variations in availability tend to have less direct impact on local economies.

Modelling

Mindful of the focus on water, and of the interplay between the main sources of water – only one of which is irrigation allowances – three scenarios are presented below:

- high level of planting and of water availability
- medium level of planting and water availability
- low level of planting and water availability.

The following two tables show the result of the modelling for the two cotton communities, St George and Gunnedah.

Table 24 shows the large differences in employment expected depending on the scale of planting in each of the three scenarios. On-farm employment is likely to vary by a factor of 4 between the low planting and high planting scenarios. And the flow-on employment would vary by a factor of 2 for bedrock business and almost 5 for rural services businesses (no crop to process, very little employment) in St George. In Gunnedah these factors will be 4 and 3, reflecting the wider mix of agricultural processing (other than cotton) in the region. This latter difference also reflects the lesser reliance on agriculture in the more diversified local economy in Gunnedah. For St George, it is likely that the total on-farm and immediate flow-on employment would vary by a very significant 307 employees between the best scenario (445 people) and the worst (138 people). These projections take account of the changed employment response for the high/medium and worst scenarios, and amounts to some 14% of the Balonne Shire workforce in 2006. For Gunnedah, the variance would be 390, between the best scenario (633 people) and the worst scenario (243 people). This is a smaller proportion (8%) of the larger Gunnedah workforce.

Table 24 Employment impacts, St George and Gunnedah

	Hectares planted		Estimated farm employment		Estimated bedrock business employment		Estimated rural services employment	
	St George	Upper Namoi	St George	Upper Namoi	St George	Upper Namoi	St George	Upper Namoi
High planting	26,000	30,000	141	162	113	138	192	333
Medium planting	14,000	12,000	76	65	90	110	117	226
Low planting	4,000	6,000	28	42	68	83	42	118

Table 25 shows the scale of the snowballing impact from lower planted areas and lower harvest volumes. Higher costs per hectare have been factored in for the worst scenario, with the ratio of best scenario and worst scenario planting costs based on experiences tracked across good and bad years in the 2006 review (Cotton CRC 2006), adjusted for inflation since then. The higher water and labour costs anticipated from the worst case have also been factored in, leading to 10-12-fold differences in the amount of discretionary spend from growers into the community.

Table 25 Cost impacts, St George and Gunnedah

	Estimated of local expenses (excluding water)		Estimated costs per hectare		Estimated profitability per hectare		Estimated discretionary spend	
	St George	Upper Namoi	St George	Upper Namoi	St George	Upper Namoi	St George	Upper Namoi
High planting	$65,000,000	$75,000,000	$3,620	$3,620	$1,400	$1,400	$36,400,000	$42,000,000
Medium planting	$35,000,000	$30,000,000	$3,620	$3,620	$1,100	$1,100	$15,400,000	$13,200,000
Low planting	$12,000,000	$18,000,000	$4,550	$4,550	$700	$700	$2,800,000	$4,200,000

Table 26 shows the outcomes of the modelling for Waikerie, noting the different approach from citrus growers compared with cotton growers where planting is not a variable, while water availability and cost still is. The modelling takes South Australian citrus production costs (adjusted for inflation) to estimate the value of local spending – on items including labour (approximately 50% of expenses, covering both pruning/maintenance and harvest), fertilizers, pest control, freight and water. The modelling is based on production history over the last decade that saw volumes remain fairly steady through seasons of more and less water availability, with farm gate prices the main determinant of profitability per hectare and the consequent discretionary spend in the community.

Table 26 Employment and spend impacts, Waikerie

	Estimated farm employment	Estimate of local expenses (excluding water)	Estimated bedrock business employment	Estimated rural services employment	Harvest labour	Estimated profitability per hectare	Estimated discretionary spend
10% less water	20	$18,200,000	40	80	320	$4,200	$10,920,000
25% less water	20	$18,200,000	30	60	300	$3,700	$9,620,000
50% less water	10	$12,194,000	20	40	150	$1,500	$3,900,000

The modelling outcome for Waikerie shows that the direct and flow-on levels of employment vary from 440 in the best scenario, to 210 for the worst scenario. This is a change of 230 people, some 32% of the jobs in Waikerie. The Waikerie modelling shows a nearly 3-fold variance in grower discretionary spend between the best and worst scenarios, indicating significant flow-on impact across the local economy.

Critical points in the supply chain

The modelling supports the findings from the industry analysis and interviews, that there are some critical points in each of the local supply chains.

In the cotton communities, one of the most critical is the grower planting decision, and it is this decision that has the greatest immediate flow-on effect into the local economies. A critical part of sustaining local economic viability in these two communities is ensuring that this grower decision is based on the best possible information – on water, weather, supply and demand factors.

In Waikerie, the crucial decision is whether or not to keep an orchard or vineyard in production, and how much (more) to invest in water efficiency technology. The interviews suggested that growers that are still in the industry in Waikerie have already implemented most of the readily available and cost effective water efficiency technologies, and there is little room for further gains.

The second critical point is the maintenance of local processing and value-adding capacity, which not only services the growers' needs but also has significant local employment flow-on effects. With widely varying production levels it is clear that some value-adders and processors are still reviewing their viability. And while in the wider context the loss of such a facility will mean more business for a neighbouring region, the local flow-on effect from less employment could be important.

The third critical point is the nature and extent of the local 'farm business infrastructure' like rural supplies, contractors, aerial services, transport etc. Wide variations in planting/production levels have placed pressure on the long-term viability of some of these businesses, and there is clearly some risk that these may fold if turnover shrinks too much or becomes too erratic. While there is no doubt that remaining growers would source their products/services from elsewhere, the loss of local jobs in any of these fields would have further negative impact on the local economy.

Enhancing economic adaptation

The economic histories of each of the study areas were summarised earlier in this report. The pattern in each has been similar, in that each has gone through major structural changes in the last 100 years or so. Each local economy and each community has demonstrated its capacity for adaptation: changes in crop varieties; changed practices and scales of production; and changes in the people involved and the economic infrastructure around them. The cotton growing areas are clearly continuing to operate in a

volatile market, and citrus growers too are in the midst of a long-term change from juice fruit to high quality easy peel table fruit.

Seasonal water availability and climate take their places in the influences on the agricultural enterprises in the study areas alongside these longer term structural changes. Water issues are topical and immediate, while the longer term structural changes are less immediately visible, but are probably more significant in terms of the sustainability of local economies. Growers and communities are clearly prepared for and able to handle lean seasons. But both can get to breaking point if the lean times continue. As one farmer said in the *Beyond the Farm Gate* study (Houghton 2005):

> "There's nothing worse than drought following a couple of dry years".

Longer term sustainability is about retaining people and business in the community, and seeing the business mix adapt to and change with external drivers. A study into regional economic sustainability done in 2011 for the National Institute for Rural and Regional Australia used a four-quadrant approach to depicting the pressures on regional communities in terms of working population (growth or decline) and employment mix (diversity increasing or decreasing) (NIRRA 2012).

Working population			
	Increasing	Growing around dominant industries, exposure to external shocks, *muscle town*	Growing and diversifying *thriving/reviving town*
	Decreasing	Consolidating around dominant industries – no structural adjustment *dying town*	Effective 'structural adjustment' *turnaround town*
		Decreasing	**Increasing**
		Employment diversity	

Figure 55 Typology of population and diversification dynamics

Source: NIRRA 2012

This depiction is useful in thinking about enhancing economic adaptation in the three study sites, as it highlights the importance of growth in at least one of the axis variables: size of the working population or employment mix. The long-run structural challenges tend to reduce employment diversity, and either increase the working population if the town is in a 'boom' area, or decrease it if not. St George has been through its cotton boom and is now consolidating. Gunnedah is restructuring and developing (slowly) a broader economic and population base. Waikerie is in the midst of citrus industry structural change, and is taking active steps (through the Riverland Sustainable Futures process) to build alternative economic engines.

Clearly, if the working population is not increasing (as in St George and Waikerie), it is crucial that employment diversity does.

Conclusions

It is apparent that in modelling local economic activity in these three rural study areas, the main players in the supply chains are experienced in handling variability in agricultural activity levels, and that there is not a simple, linear relationship between planting, harvest and local flow-on spending. In particular, it is not accurate to predict flow-on spending by growers, or employment levels on farms or

processing businesses, as a fixed proportion of areas under crop. There is a tipping point for grower and business adaptation between 25% and 50% reductions in water availability, with practices for both groups changing significantly across this boundary.

It is important to understand the nature of these tipping points and improve understanding of the impacts of changes on agricultural production, so that communities have access to more robust and more intuitively believable modelling. Earlier simplifications which base modelling on fixed relationships like employment per megalitre of water used have had little traction in communities. The 2010 community profiles done for the Basin Plan included the assertion that:

> "The relationship between water availability and economic activity is more or less a straight line." (p940)

The interviews, local histories and modelling done for this project have shown that this is clearly not the case, and that to base further research on such an erroneous assertion is to invite community criticism.

This project has been about testing proof of concepts in an alternative approach to understanding the linkages in small agricultural economies. It has tested a bottom-up approach built around intelligence about the flows within the local economies, and how these have adapted to external changes over the last decade or so. This approach seems useful in being able to generate believable scenarios for local futures, but will require more fine tuning before it is methodologically robust.

Chapter 5 - Demographic modelling

Authors: Dean Carson, Doris Carson and Andrew Taylor

Purpose and Approach

This project aimed in part to understand how communities become vulnerable to demographic threats (such as the outmigration of young people) and to map the demographic flows in three case study communities. The project also sought to model how changes in the economic and social characteristics of a community might be correlated with demographic change.

A multi-faceted approach to demographic modelling was employed:

1. baseline analysis of gross demographic change (total population, age and sex) using existing census, estimated resident population and population projections data. The analysis was conducted across whatever timeframe for which data were available

2. baseline analysis of patterns of migration in to and out of the case study communities between 2001 and 2006

3. identification of key drivers of demographic change based on rural demographic theory and input from the primary data collection and community engagement components of the Securing the Wealth and Wellbeing of Rural Communities project

4. construction of agent based models of community populations that allow exploration of the potential demographic impacts of changes in the economic and social characteristics of the community over the next 15 to 20 years

5. testing of the demographic analysis with key informants in the case study communities.

At the time the modelling was being conducted, the most recent comprehensive demographic data were drawn from the 2006 Census. 2011 Census data were released in sufficient detail (including migration and place of work data) in late October 2012, and the baseline analyses and agent based models have been updated with 2011 data, but not yet tested with the case study communities.

The three case study communities were: Waikerie (South Australia); Gunnedah (New South Wales); and St George (Queensland). Due to delays in the conduct of other components of the project (particularly the community engagement component), the modelling process was initially completed in Waikerie. Community advocates are progressing the process in the Namoi. Multiple adverse weather events created significant barriers to engagement in St George.

Baseline Analysis of Gross Demographic Change

Historical Data

The first task was to collate historical census data for each of the communities, and put together a ‘demographic timeline’ covering as long a period as possible. Historical census data is not only valuable because it helps engage communities (who are usually interested in their own histories), but because it provides insights into the extent to which the communities have previously been susceptible to substantial short term demographic change.

We were able to access census data for Gunnedah from 1861 (including age and sex data), for St George from 1864 (including age and sex data), and for Waikerie from 1901 (including age but not sex). Waikerie was only settled as a South Australian ‘village’ in 1894 (Mack 1994). Historical data should always be treated with caution because of changing (and no longer accurately recorded) census

boundaries. Nonetheless, the data helps identify critical demographic periods (which are often what leads to substantial census boundary changes) and their duration. This is illustrated by the apparent demographic change in St George between 1891 and 1991. In 1891, the 'St George' label referred to the entire district, but by 1991, it was being used to refer to the township only.

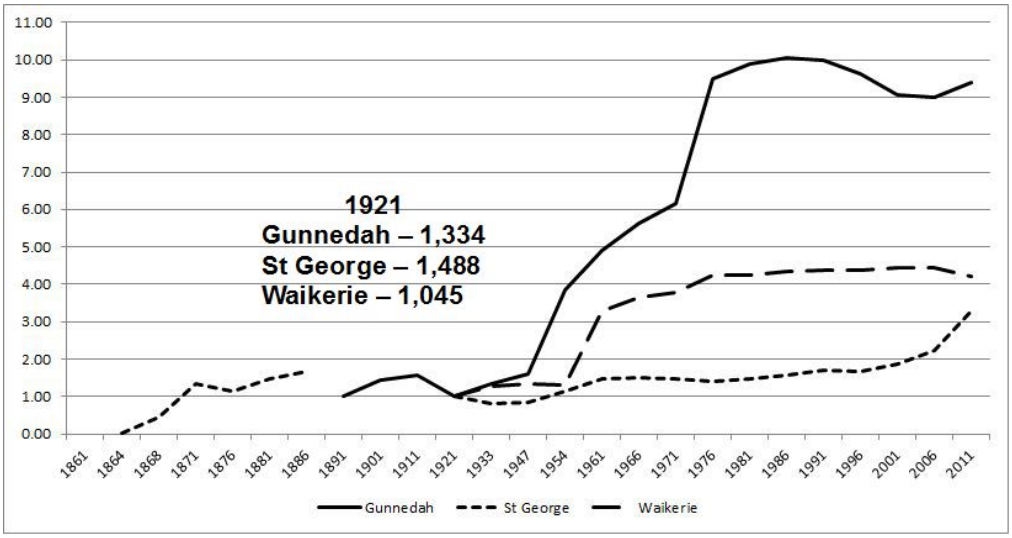


Figure 56 Summary of population growth in case study communities, 1861-2011

At the time of the 1921 Census, the three case study communities had similar populations (between 1000 and 1500 people), but their demographic paths diverged dramatically after World War Two. Gunnedah experienced rapid growth immediately after the war, and the growth pattern persisted until 1976, when the population was about the same as it is today. Waikerie also grew rapidly after the war, but began to stabilise in the late 1960s/ early 1970s. St George had a much more stable population after the war, but has experienced a period of substantial growth since 2001.

Existing Population Projections

The second task was to examine existing population projections for the three communities. The examination is somewhat limited because population projections are rarely produced at what we might call 'community' level when the communities have less than 5000 or 10000 people. We have instead examined the smallest region including the community for which there are projections. Projections at small area level are notoriously unreliable (Wilson and Rowe 2011; Howe 1999). They are nonetheless extremely important because they reflect and direct government views of what the future might be for the area. They are used to help determine levels of government investment, and they provide 'the number' (or, occasionally, a small range of numbers) that local administrators are required to attend to in their planning processes. The projections described here are drawn from the Australian Government Department of Health and Ageing (www.health.gov.au) because they have a consistent approach across Australia. State Government departments also produce projections. In each case, we have made the 2006 population estimate the baseline, and the Y axis shows proportional variation from the baseline of 1.00.

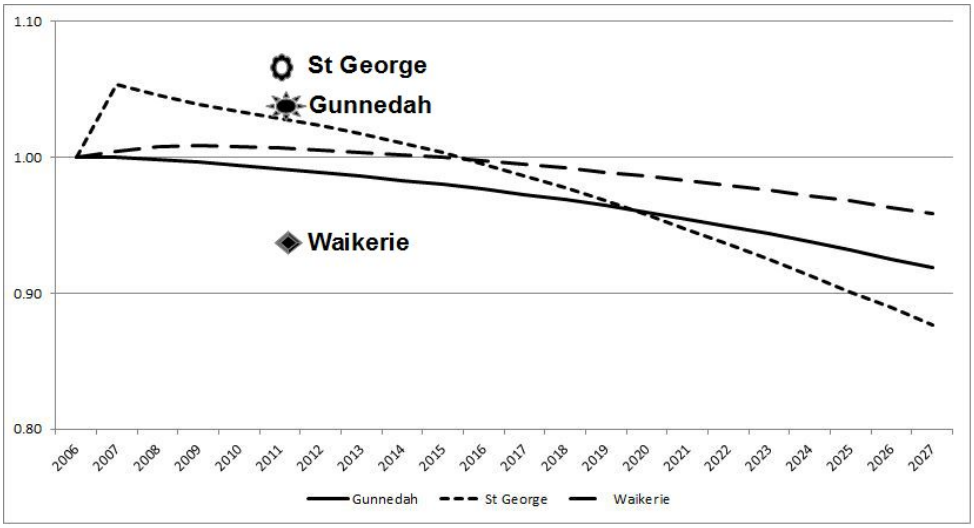


Figure 57 Expectations for future growth in case study communities

The graph also shows (the internal markers) the revised estimated population for each community following the 2011 Census, demonstrating the inaccuracy of the population projections over even a short period of time. The graph also highlights the 'trend' nature of standard population estimate models. Apart from a hasty adjustment of the St George population to account for the previously unanticipated rapid population rise in the mid 2000s, the projections follow simple trend lines. This is clearly in contrast to the more volatile patterns observed historically.

The foundation of existing population projection models is analysis of change over the previous one (perhaps two) Census periods. This analysis may be tempered by some expectation of new long term and broadly applicable trends (such as declines in fertility, expectations of the impacts of the mining boom and so on), but rarely, if ever, is it informed by specific understanding of local conditions. Indeed, such an approach is not viable (or warranted) when attempting to develop consistent, hierarchical (i.e. requiring that all sub-total projections sum to the total projection), projections at State or National level. It is for this very reason, however, that externally produced projections tend to be of limited value for communities. Those projections do not help answer questions such as "what might produce dramatic population change in my town?" As we see in the example of St George and the 'revision' of the model following observance of population growth in the mid 2000s, existing projection models react to such dramatic changes much more frequently than they anticipate them.

Gross Demographic Change 2001-2011

The graphs above illustrate change in the total population of the case study communities, but we are also interested in changes in the age and sex structure. Changes in these characteristics are very good indicators of population potential and the possible future demographic 'shape' of population. 'Shape' is depicted in population pyramids (see Figure 58 below). Demographic researchers suggest that post-industrialised societies have population pyramids that transition from a 'beehive' shape, where there are relatively many young people, to a 'coffin' shape where the population is more evenly distributed and there are proportionally many older people (McDonald 2000). In extreme cases, pyramids may also become 'inverted', reflecting a large number of older people. Smaller populations, such as those of our rural communities, are also subject to 'bubbles and craters' reflecting the abundance or absence of particular age or sex groups (typically late teenaged and early 20s aged people) (Martel et al. 2011). Beehive pyramids suggest greater population growth potential because of relatively large numbers of people in the reproductive age groups. Coffin pyramids suggest potential for population decline as deaths outnumber births. The location of bubbles and craters within a pyramid makes a difference to the population potential.

The balance between males and females can also be instructive. Communities with poor balance, particularly among the young adult population, tend to be subject to long term population decline as people leave to seek mates or start families elsewhere (Gloerson et al. 2009).

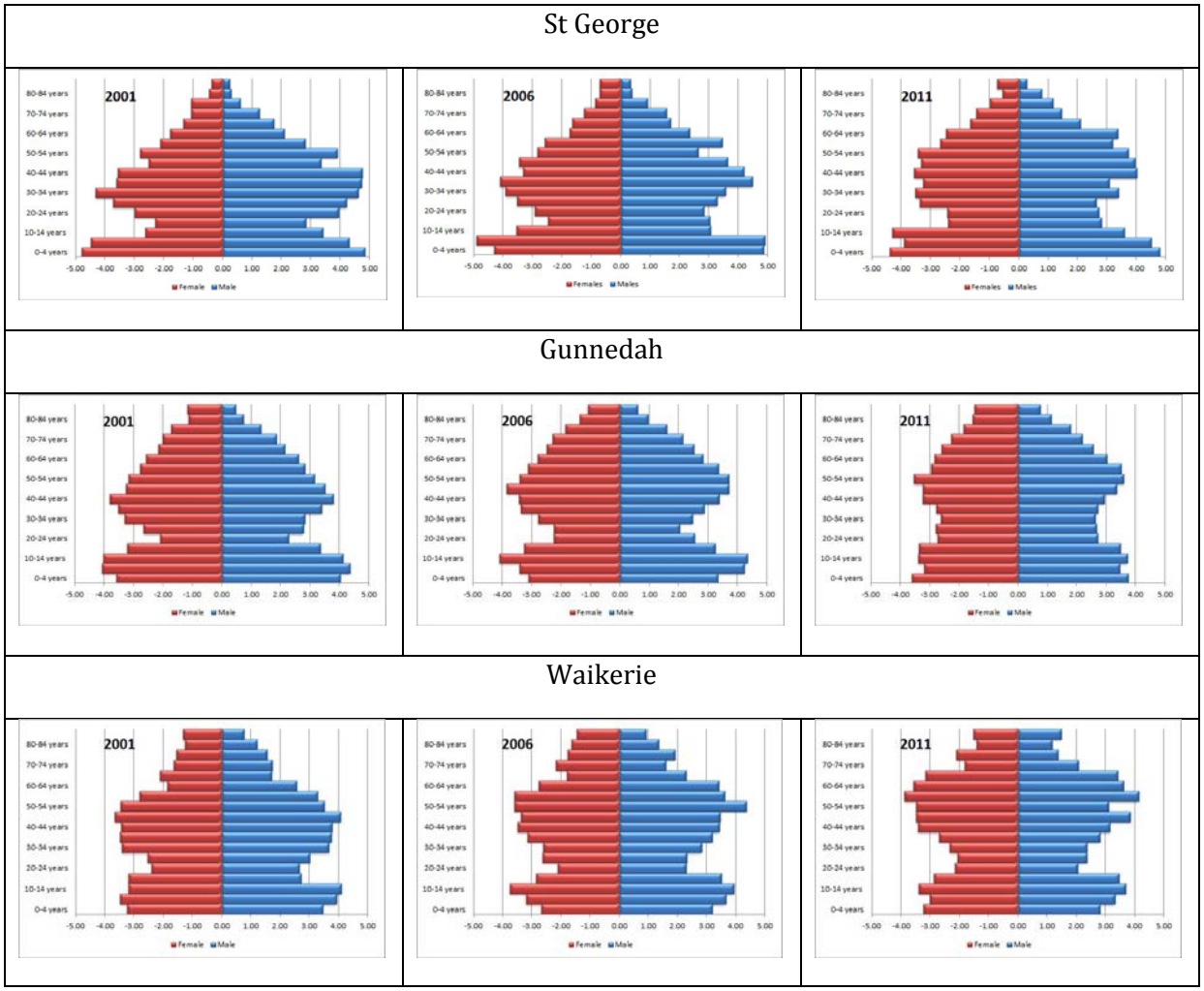


Figure 58 Population pyramids for case study communities, 2001-2011

The population pyramids again emphasise the uniqueness of each community. St George has been much more male, and has had a younger age profile than the other case study communities. It is ageing a bit more slowly, and has had a 'crater' move from early teens to early 20s age group during the past decade. Gunnedah has developed more typically of a transition to a coffin pyramid, with an increasingly even age distribution. Waikerie has also aged towards a coffin shape, but has retained a bubble of people aged in their late 50s and early 60s (in 2011), and a much more severe crater of people aged in their 20s.

The analysis of gross demographic change over time helped construct the agent based population models by providing a demographic 'check' on performance of the models under various scenarios. For example, scenarios which tended to cause dramatic change in the shape of the population (rather than the overall size) were examined in more detail to ensure that assumptions in the model (the rules that governed agent behaviour) could be defended.

Migration Analysis

Overview

The Census asks what you consider to be your 'usual residence' on Census night, what your usual residence was one year prior to the Census, and what it was five years' prior to the Census. For the purposes of this research, migration was considered to occur when an individual changed their stated 'usual residence' from one community to another. Moves within a community were not considered. Changes in migration patterns have far more significant impacts on regional and local population size and shape than births and deaths. Even at the national level, there were approximately 800 000 interstate migration events in 2011, and 700 000 overseas migration events, but just 150 000 births and 130 000 deaths. In our case study communities, there were between 800 (St George and Waikerie) and 2000 (Gunnedah) women broadly of child bearing age at the 2011 Census. Even dramatic variations in the annualised fertility rate would result in a net gain or loss of just a few babies in populations of this size. On the other hand, inter-regional migration varies across Australia from a few per cent of the population each year to over 50% of the population (rates regularly experienced in parts of Darwin, for example). Applied to St George, for example, this could mean anywhere between a couple of hundred and two or three thousand moves in or out in a year, with dramatically different demographic impacts depending on the net effects of migration (age, sex, and direction of flows).

The migration analysis serves two core functions. The first is to establish a 'baseline' reflecting the nature of flows that have been experienced in recent times (2001-2011) in terms of their size and composition (largely age and sex but also the working characteristics of movers). Scenarios that are supposed to influence flows can then be assessed against the baseline. The second function is to describe the spatial distribution of flows – where do people move to and from? This task is important because moves to and from relatively close locations are more predictable than those to and from more distant locations (Carson 2011). In other words, if observed flows are relatively localised, it will be easier to assess the impact of events (hospital or school closures, new economic developments, severe weather events etc.) than if they are more dispersed.

Baseline Flows Analysis

The Census asks people to record their current place of 'residence' (where they think they will live for the majority of the year), their place of residence one year prior to Census night, and their place of residence five years prior to Census night. The baseline flows analysis compares the age and sex of in-migrants and out-migrants from our case study communities over both the one year and five year periods, and for 2011 and 2006 Census data. We want to establish how consistent or volatile migration flows are in each of the communities.

Waikerie and Gunnedah had very similar out-migration 'curves' (see Figure 59 for the example of 2006-2011 outmigration patterns), while St George was distinctly different. Overall, about 15-20% of the population of Waikerie and Gunnedah out-migrated every five years, and about 5-7% migrated out every year. The out-migration from St George between 2001 and 2006 was 38% of the population, and between 2006 and 2011 was 30% of the population. Annual out-migration rates were between 8 and 10%. Of note, St George experienced 'youth out-migration' amongst a younger cohort than did Waikerie or Gunnedah, and the migration curve remained high for people aged in their 30s.

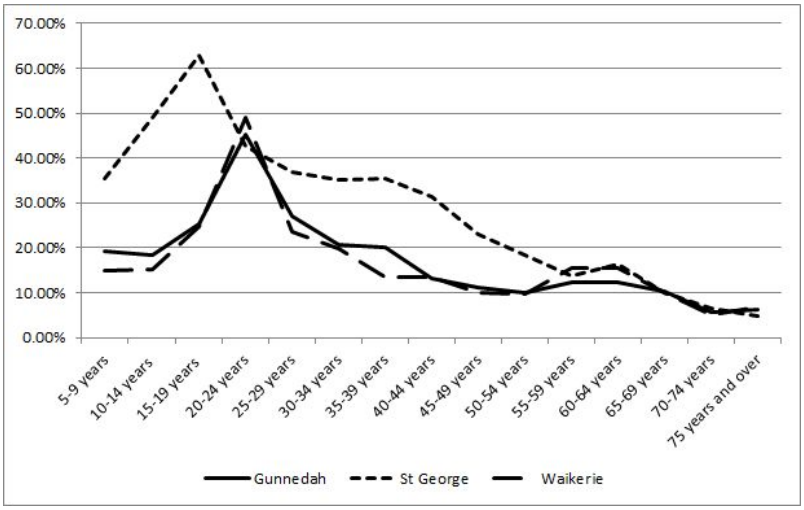


Figure 59 Age specific out-migration rates 2006-2011

The pattern of in-migration varied substantially between the three communities (see Figure 60). Overall, a volume of people equivalent to 16-18% of the population migrated in to Gunnedah and St George between 2006 and 2011, and a volume of people equivalent to 12% of the population migrated in to Waikerie. There is strong evidence of 'escalator' labour migration (Fielding 1995) in to Gunnedah and St George with large numbers of people in their 20s moving in to the communities. This is less marked in Waikerie, but Waikerie is distinguished by relatively large in-migration of retirement age people (65 years and over) indicating amenity migration (Bures 1997).

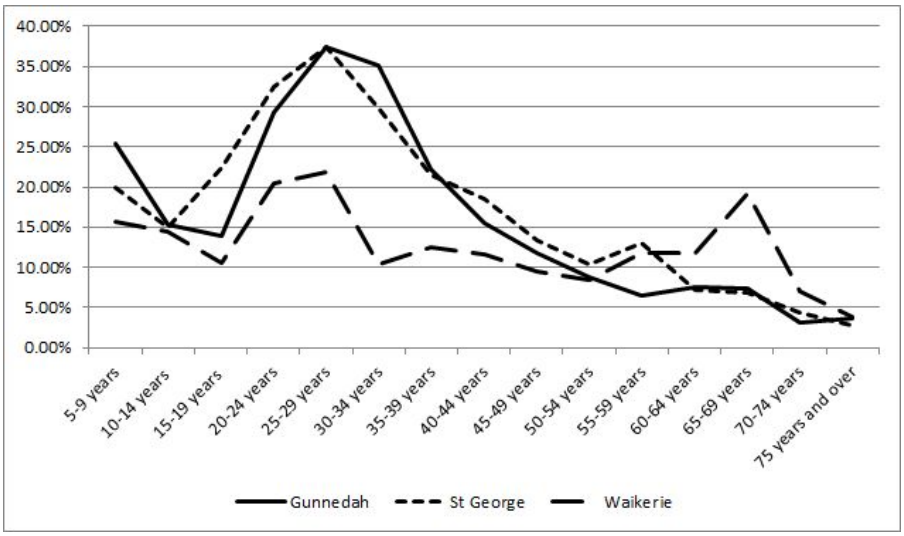


Figure 60 Age specific in-migration rates 2006-2011

A comparison of Figure 59 and Figure 60 suggests that in-migration and out-migration are somewhat independent attributes of population change at the community level. Indeed, there were relatively moderate correlations (around 0.5-0.6) between age patterns of in-migration and out-migration from the three communities across the ten year time period. In other words, it is difficult to use knowledge of one direction of flow to predict the other direction of flow. This is an important issue in constructing models of demographic change which therefore need to consider separate drivers of in-migration and out-migration.

There may also be separate drivers of migration for males and females. While the migration curves look similar (see Figure 61 for the example of Gunnedah in-migration between 2006 and 2011), there are important differences in that female in-migration peaks at earlier ages than male in-migration, and

in Gunnedah and St George (but not Waikerie), there was another 'bubble' of male in-migration at pre-retirement ages, indicating the potential of late career 'escalator' migration (Martel et al., 2013).

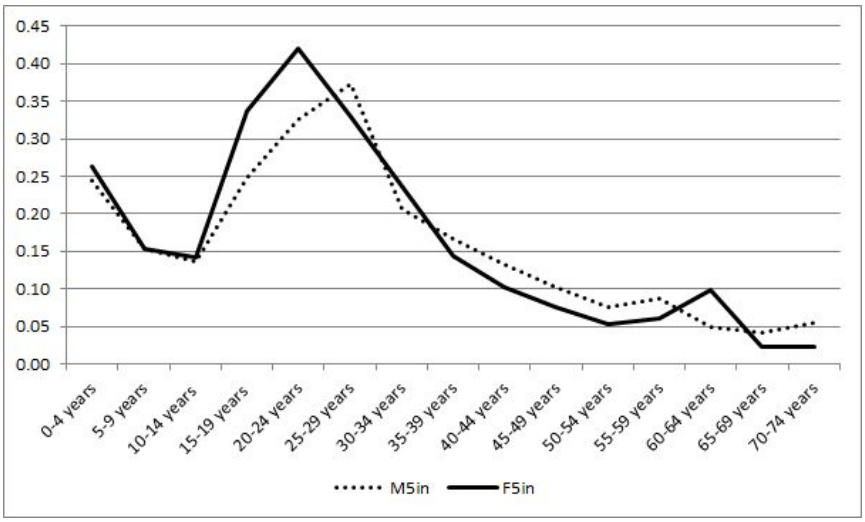


Figure 61 Age and sex in-migration patterns 2006-2011

Migration patterns vary over time. A simple example is included in Figure 62 which compares female out-migration from St George for the period 2001 to 2006 with female out-migration for the period 2006 to 2011. There was substantially higher out-migration in the first period. A volume of women equivalent to 38% of the 2006 population migrated out between 2001 and 2006, compared with 31% of the 2011 population migrating out in the second period. The 2006-2011 out-migration pattern was much more 'peaked' around the late teens and early 20s age groups, and there was not such a noticeable secondary peak around the late 50s and early 60s age groups.

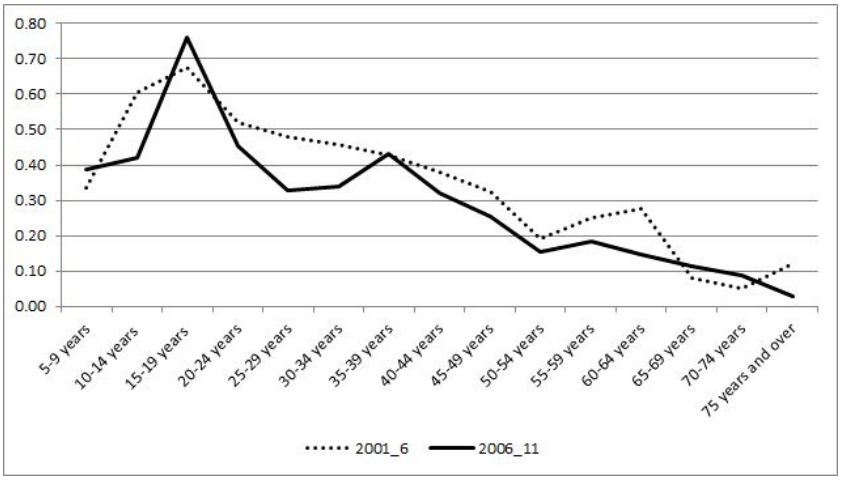


Figure 62 Female out-migration from St George 2001 to 2006 and 2006 to 2011

The migration analysis implies that the drivers of migration vary from community to community, and that while there are broad 'rural trends', such as the out-migration of young people, the potential for early career and late career escalator migration and amenity migration to rural communities, these are experienced by different communities to different degrees, and experienced differently at different times even within a single community. There are also migration events which require more direct explanation drawn from an understanding of the specific conditions applying in a community at a given time. For example, why was there a dip in out-migration of females aged in their 20s from St George between 2006 and 2011, and why was there a relative out-migration peak of women in their late 30s during the same period?

The persistence and non-persistence of patterns of migration within a community, and the persistence and non-persistence of differences in patterns of migration between communities need not only to be observed in order to inform discussion about the demographic 'wealth and wellbeing' of rural communities. They need to be explained, and explained in the context of exogenous and endogenous events ('drivers').

Spatial Analysis

The spatial patterns of migration in to and out of the three case study communities are relatively constrained (see Figure 63). In the case of Gunnedah, the top five sources of in-migrants between 2006 and 2011 (including the Hunter Valley and Tamworth) accounted for 62% of all in-migration. Towns in the immediate vicinity (Tamworth, Armidale, Inverell etc.) collectively accounted for nearly half of all in-migration, and about 40% of out-migration. In the case of St George, the top five sources of in-migrants between 2006 and 2011 (the Darling Downs and Wide Bay-Burnett regions of Queensland, the northern region of New South Wales) accounted for 64% of all in-migration. Towns in the immediate vicinity (Roma, Quilpie etc.), however, accounted for just 20% of in-migration and 10% of out-migration. The dominant destination for out-migrants was the Darling Downs region. In the case of Waikerie, nearly 40% of in-migration between 2006 and 2011 came from Adelaide, and nearly 40% of out-migrants moved to Adelaide. In-migration from the local region (Loxton, Renmark, Berri etc.) accounted for 40% of all in-migration, but this was less than for the period 2001 to2006 when nearby towns accounted for 50% of in-migration. Likewise, 'local' out-migration became less popular, declining from 40% of all out-migration to less than one quarter. Adelaide was the primary beneficiary of the decline in 'local' out-migration from Waikerie. The only other substantial inter-censal change in spatial patterns for the three case study communities occurred with St George, where the Wide Bay-Burnett region (which includes the retirement town of Hervey Bay) increased its prominence both as a source of in-migrants (from 21 in-migrants to 74 in-migrants) and destination for out-migrants (from 45 to 140 out-migrants).

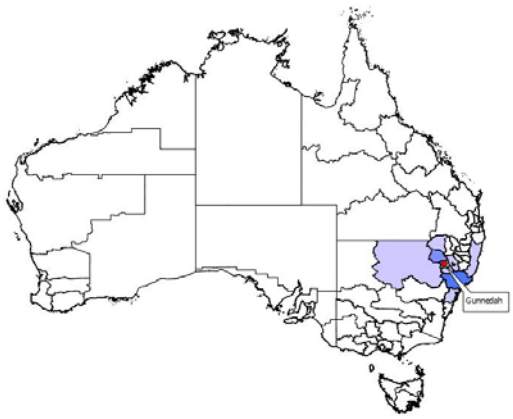
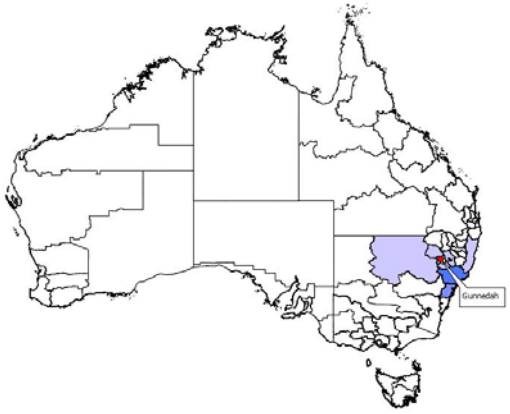
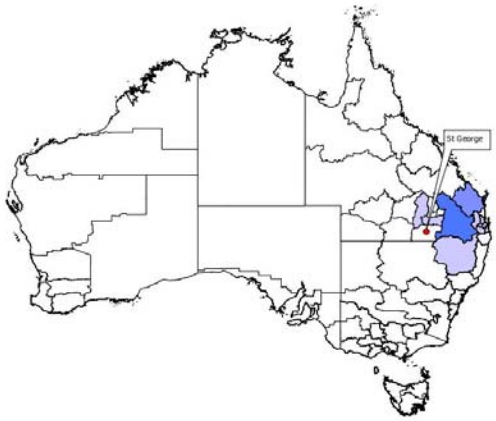
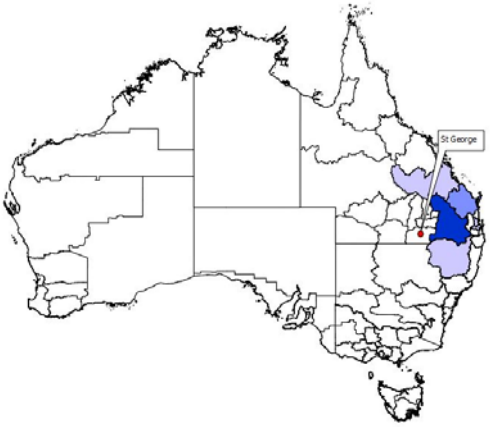
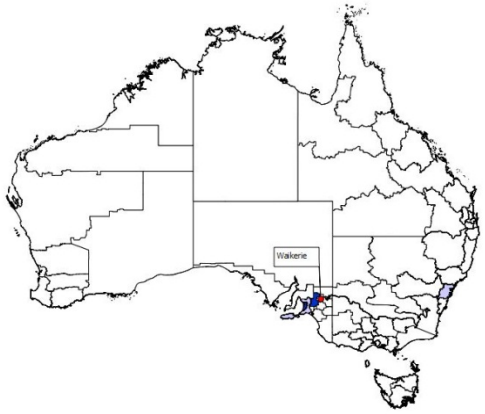
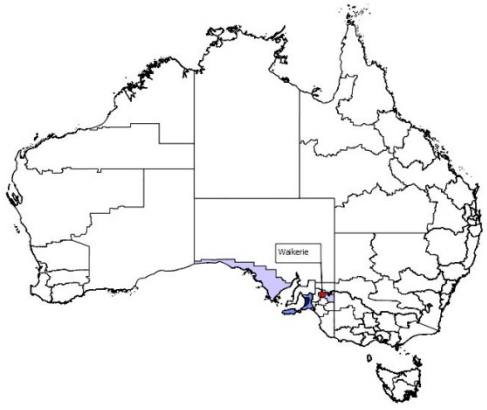
Gunnedah in-migrants	Gunnedah out-migrants
	
St George in-migrants	St George out-migrants
	
Waikerie in-migrants	Waikerie out-migrants
	

Figure 63 Sources of in-migrants and destinations of out-migrants, 2006-2011

The spatial analysis describes, particularly in the cases of Gunnedah and St George, a relatively large amount of population exchange with nearby and 'similar' regions (in terms of economic foundations). The situation with Waikerie is somewhat different, with relatively large flows to and from Adelaide, which has a substantially different economic foundation. Population ageing in Gunnedah and St George may be reflected in increasing preference for migration to 'amenity' regions (Wide Bay-

Burnett for St George, and the Hunter and Mid North coasts of New South Wales for Gunnedah). The corresponding increase in flows from those regions may be illustrative of 'reverse' migration either because of 'failed' amenity migration (Amin and Ingman 2010) or because of the renewal of agricultural employment opportunities coming after the drought (2002-9). There may be some indicators of the explanations for particular migration patterns in the Census data, but we are loathe to draw conclusions without a deeper understanding of local perceptions of drivers of demographic change, which are discussed in more detail in the next section as they relate to Waikerie.

Identifying Drivers of Demographic Change

Process

The process of identifying local perceptions of drivers of demographic change was undertaken in Waikerie in early 2012, and is scheduled to be undertaken in St George in early 2013. Part of the process has also been undertaken in Gunnedah, but the results have not yet been provided to the demographic modelling team. The process involved an initial review of community documents (newspaper articles, local government meeting minutes, local and regional planning documents and so on), and interviews with key local informants. We first examined 2001 and 2006 Census data (the most recently available at that time) and identified the broad patterns of demographic change in Waikerie during that time (population size, age and sex distributions, industries of employment, migration patterns and so on), and presented this information to key informants (in this case, a local government employee, several elected local government representatives, two local journalists, and two business owners). We asked them what they thought of our Census data analysis, what might explain the changes we had identified (including explanations relating to the quality of Census data), what other changes they would have expected to see (and why) and what they were expecting to see when 2011 Census data became available (and why). Community documents were reviewed to identify the types of demographic changes that were being reported, the explanation for those changes, and the types of changes that we anticipated or hoped for within planning documents. For example, several local planning documents described an aim for the community to attract increasing numbers of amenity migrants from Adelaide.

The local input was distilled into a set of demographic 'aspirations' and 'apprehensions'. Aspirations reflected how the community hoped to change demographically in the short to medium term future. Apprehensions reflected what the community perceived as potentially unwelcome demographic change. The aspirations and apprehensions for Waikerie were:

Aspirations

- encouraging the in-migration of pre-retired and newly retired people from Adelaide who might be attracted by the lifestyle, 'lifestyle business' opportunities (particularly relating to tourism and small cropping), and relatively affordable housing

- attracting new businesses as a result of established economic linkages in tourism and agriculture, and benefiting from ease of access to Adelaide

- reduce the out-migration of young people by making high school and university education more accessible locally (through the internet, for example)

- increase the number of tourists visiting the community to both increase business opportunities, and to expose the community to potential amenity migrants (Kuentzel and Heberlein, 2010).

Apprehensions

- increasing loss of farming families as a result of the drought and the challenges to returning to the land for those who had left

- increasing difficulty in attracting and retaining health and education professionals
- in-migration of single parent and families without employed adults as a result of relatively affordable housing
- increasing out-migration to nearby towns which have continued to be centres of local government[2].

Results from 2001 and 2006 Census

We developed a poster summarising what could be said about the play out of these aspirations and apprehensions between 2001 and 2006 (attached), and this was used as the basis for further community consultation and for informing the change scenarios included in the community survey and choice modelling exercises conducted as complementary components of the *Securing the Wealth and Wellbeing of Rural Communities* project (see section on 'Construction of Agent Based Demographic Models'). In short, analysis of 2001 and 2006 Census data seemed to reveal:

- substantial ongoing out-migration of younger people (aged in their 20s), but some evidence of increasing in-migration of people aged over 60 years). Consequently, aspirations to attract amenity migrants appeared to being partially met, while aspirations to reduce out-migration of education seekers were unmet
- Loxton as a popular destination for people moving out of Waikerie (along with Adelaide), perhaps indicating the attractiveness of the local government centre
- a net in-migration of primary sector (agriculture) businesses, but not of tourism businesses. This was a surprising result given the expectation that the drought would drive away agricultural businesses. A possibility suggested locally was the impact of a relatively good rainfall year 2005/6 which may have attracted businesses to the area where agricultural properties could be purchased at low prices. In contrast, poor recent visitor numbers may have deterred investment in tourism businesses
- relatively large numbers of young adults (aged in late 20s and 30s) who had moved in to the community but who were not working, reflecting the apprehension about unemployed people seeking affordable housing.

The poster also compared Waikerie with other similar South Australian, Australian and international communities on some of the aspirations and apprehensions. For example, we looked at the international literature relating to how communities might attract amenity migrants. We examined how tourism to rural areas across Australia was changing, and what this might mean for local business opportunities, and we modelled the changing distribution of business owners in South Australia. The latter was particularly interesting locally, as it showed a movement away from northern and inland regions to Adelaide and coastal regions.

The 2001 and 2006 Census analysis helped identify what sort of scenarios for future change were realistic (for example, the scenario of large numbers of young people remaining in the community and doing university education at a distance appeared unrealistic given local history and the experiences of similar communities elsewhere in Australia) and which scenarios appeared to be playing out already (for example, the loss of local services as a result of local government amalgamation and associated redistribution of population).

[2] In 1997, Waikerie local government was amalgamated with Loxton local government, and the local government head office was located in Loxton.

Initial Analysis of 2011 Census

Work is continuing on analysis of 2011 Census data. A presentation was made to the Waikerie community in the first half of 2013[3]. Some initial analysis was presented to key informants in the community in August 2012, and some further analysis has been conducted following the release of more detailed Census results at the end of October 2012. The key foci of the analysis has been assessing the demographic impact of the 2002-2010 drought, and determining whether trends identified for the 2001 to 2006 period have persisted or altered.

The 2011 Census analysis will be documented in full once final release data (due March 2013) are incorporated and the analysis has been shared with the Waikerie community (offering them an opportunity to respond to the analysis and suggest additional items of interest). Some interesting observations have emerged already, however, including:

- an apparent re-distribution of population from 'land' areas into 'town' areas. The dynamic appears to be (although further migration analysis is required) a movement off the land and out of the community by farm labourers (not necessarily business owners) and a movement in to town of health and other social service workers coming largely from Adelaide

- as a result, while the overall population of Waikerie region is believed to have declined by more than 400 people, the population of the town itself may have grown by 200 or 300 people

- the trend towards in-migration of older people has continued, and appears to have accelerated (locals note the development of a relatively large retirement village attached to the caravan park in recent years)

- trends around out-migration of younger people have continued

- there was a relatively large in-migration of low income single parent families

- no noticeable increase in tourism, or in-migration of tourism businesses

- increases in the number of people who live in Waikerie but work elsewhere (including in the local government centre of Loxton), and increases in the number of people who work in Waikerie but live elsewhere (including in Adelaide)

The critical 'paths' at this stage appear to be the 'rural urbanisation' of the community (changing not just the spatial distribution of population, but the characteristics of the population), the accelerated ageing of the population, and the reduced household and personal wealth (reflected in incomes) of the working age population. These paths have emerged over a relatively short period of time, and the demographic modelling for the *Securing the Wealth and Wellbeing of Rural Communities* project needs both to account for these paths, and to be constructed in such a way that future path changes can be anticipated.

[3] Work with the Waikerie community will continue throughout Stage Two of the *Securing the Wealth and Wellbeing of Rural Communities* project. In February 2013, we are giving a public seminar specifically related to the aspirations and apprehensions to do with the tourism industry, and what the project has learnt about the potential impact of changes in the tourism economy on local demography. A more detailed 2011 Census data presentation relating to the total set of aspirations and apprehensions would be ideally scheduled for April/ May 2013.

Construction of Agent Based Demographic Models

Justification

The justifications for developing new demographic models (beyond those already offered by the Australian Bureau of Statistics and various State/ Territory Government agencies) for the case study communities were:

- the desire to explore demographic change at a more 'local' spatial level than included in existing models (the importance of which is illustrated by the 'rural urbanisation' of Waikerie)

- the desire to integrate community-provided information into the modelling process, and in particular to explore 'scenarios' of change in the community arising from or linked to local demographic aspirations and apprehensions. Existing models can conceptually undertake scenario analysis, but they are not specifically designed to do so

- the desire to explore a wide range of possible demographic futures arising from potential emergent demographic 'paths' (such as the varied implications of relatively affordable housing and its relationship to in-migration patterns). Some existing models produce 'high, medium and low' projections, but with limited interpretation of why one or other of these outcomes might occur

- the ambition to have the model consider each member of the community as a unique decision making entity. Existing models apply standard probabilities (probability of leaving the community, probability of dying, probability of having a baby etc.) across the entire population based on simple group characteristics usually limited to age and sex

- the ambition to have individuals influence one another – as members of family or social or professional groups who might mimic or counteract one another's behaviours. For example, the tendency for demographic events (youth suicide, teenage pregnancies, in- or out-migration flows etc.) to 'cluster' within a population, and within certain parts of the population is well known (as 'neighbourhood effects' (Subramanian and O'Malley 2010). Existing models, however, smooth these events out over time.

These considerations resulted in the adoption of an agent based demographic modelling tool which is being developed separately through international collaborations including Flinders University researchers attached to the *Securing Wealth and Wellbeing of Rural Communities* project (Koch and Carson 2012; Carson et al. 2012). The demographic modelling tool has been constructed using the open source NetLogo agent based modelling software (ccl.northwestern.edu/NetLogo).

Modelling Software and Base Model

Constructing an agent based model in NetLogo involves describing a population of 'agents' (individual participants in the model) on a 'field' delineated by an area of the computer screen (see Figure 64), and subjecting them to 'rules' of behaviour. Agents act according to those rules (which might include moving around the field, interacting with each other, 'ageing' and so on). The model progresses in time units ('ticks'). Agents are asked to re-apply the rules in each new time unit. A common application of NetLogo for demographic purposes is to explore segregation of urban areas over time (see, for example, Koch's (2009) model of socio-economic segregation in the city of Salzburg) based on rules which incentivise agents to seek housing as close as possible to other agents of particular type (usually those with more socio-economic resources). Agents continue to move around the field until they can no longer find new housing which gets them any closer to the desired neighbourhood (or until a particular point in time is reached). Koch's work (and others) has demonstrated that a very complex organisation of agents based on their socio-economic characteristics emerges from even such a simple model, and that that organisation closely resembles what is observed in empirical data sets.

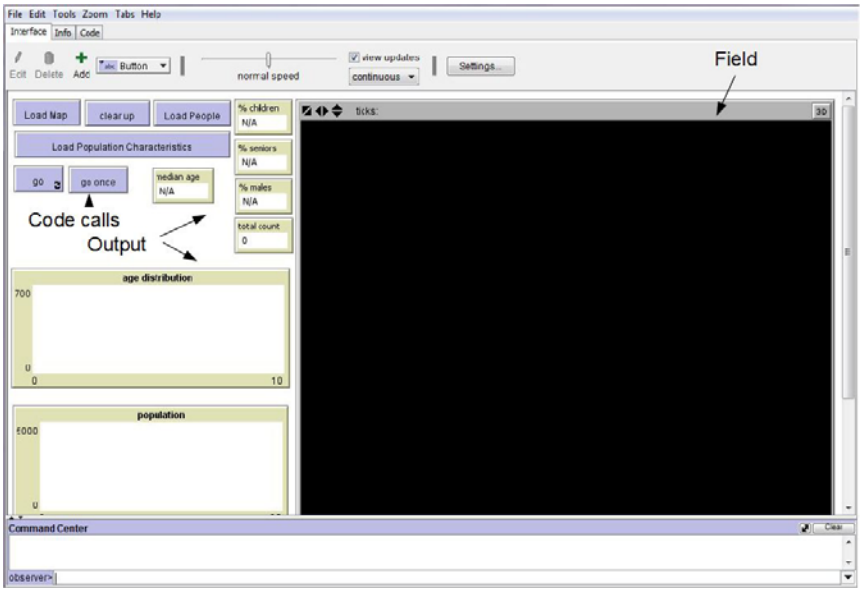


Figure 64 NetLogo basic interface

NetLogo allows agents to initially populate the field at random, and it allows agents to be ordered at random, so that each time the model is run, agents can have different starting positions, and react to previous behaviours by different co-agents. For example, in the Salzburg segregation study mentioned above, one run of the model might allow agent number 30 to select a new house before agent number 31 does, but in another run, the order may be reversed. In this way, the model can dynamically produce clusters of events (which emerge from coincidental ordering of agents or location of agents across the field). It also means that different results are produced by the model each time it is run[4].

The stochastic properties of NetLogo models are ideal for our purposes, as they allow us to examine why different demographic outcomes might emerge from apparently similar starting conditions. For example, the demographic destiny of Waikerie may be quite different if farm labourers leave before amenity migrants arrive (the population may age more dramatically) than if the opposite occurs (there may be less affordable housing available and so fewer new migrants arrive). By running the model many times, an assessment can be made about the potential diversity of outcomes that could be expected from a particular scenario (depending on timing and neighbourhood effects). Additionally, each model run can be separately analysed to explore why such an outcome might occur. Examples of these analyses are given in the 'Model Execution' section.

The NetLogo demographic modelling tool adapted for the *Securing the Wealth and Wellbeing of Rural Communities* project provided a simple and easy to use base structure:

1. a population of agents representing individual members of the case study community could be drawn from a text file (making it easy to substitute one starting population with another)

2. the model included rules for in-migration, out-migration, giving birth, and dying based on a small number of individual characteristics – age, sex, employment status, length of time in the community, and (for women) the number of children previously issued

3. initial probabilities of these events for an individual were determined by a set of polynomial curves which represented best fit to previously observed data for the community (see Figure 59 for the example of age specific migration curves), but individual agents developed their own probabilities as the model evolved based on the characteristics described in 2 above and their previous behaviour:

[4] Although specific runs can be replicated by manipulating the software's random seed.

    a. for example, an individual agent may increase or decrease their probability of out-migration based on how long they have been in the community, how many children they have and so on. These characteristics are in turn dependent on other emergent probabilities (having children depends on age, employment status, and number of previous children, for example) and so rarely will two agents have the same probabilities across all behaviours, even if their starting characteristics were identical

4. curves can easily be adjusted to represent assumptions around new scenarios without having to re-write the model. Similarly, applying different curves to different populations is a straightforward task

5. the model progresses in increments of one year, which is a time increment compatible with standard demographic event probability calculations (age specific fertility rates, for example)

6. the model can be run many times with different scenarios, and comparing similar scenarios in different communities

7. the simplicity of the NetLogo programming language makes it relatively easy to integrate the demographic model with the decision support tool also developed within the *Securing the Wealth and Wellbeing of Rural Communities* project (see Figure 70).

The model has some weaknesses which are currently being addressed, and will be incorporated as far as possible in Stage Two of the *Securing Wealth and wellbeing of Rural Communities* project:

- agents do not yet have rules for the formation of family and social groups which could further advance the execution of neighbourhood effects. For example, out-migration of a parent is not yet linked to out-migration of the parent's children. This weakness is being addressed through specification of family links in the data input file, and through use of spatial proximity of agents in the field to imitate social groupings

- probability curves cannot yet be changed 'on the fly' as the model is running. This means that, while we can ask the question "what would happen if the hospital closed this year?" we cannot easily ask the question "what would happen if the hospital closed in five years' time?" This weakness is being addressed through development of additional input menus which can specify when a change in underlying probabilities will be 'forced' on the system, and what the nature of that change will be

- in-migration probabilities are currently calculated as a function of the characteristics of the resident population (despite the observation earlier in the report that in-migration is only moderately correlated with resident population characteristics). This is because it is not possible to program an (essentially) infinite population of agents who are not members of the community, but who may become members through in-migration. This weakness is being partially addressed by identifying the probability that specific out-migrants will be replaced. If, for example, a teacher migrates out of the community, there is a very high probability that a new teacher will migrate in. This might not, however, be the case for a farm labourer or unemployed single parent. There are also some attempts to develop a 'known' external population representing the major sources of in-migration and the probabilities of particular individuals within those known locations (such as Adelaide or Loxton for Waikerie) moving to the focus community

- agents must be present within the model for one year, while it is appreciated that people who are present for less time than that can and do have significant demographic impacts on the system (tourists, non-resident workers, short term contract and seasonal workers etc.) (Hannam et al. 2006). This weakness is being addressed by allowing 'temporary' populations simulated from tourist data and 'place of enumeration' Census data to influence social networks by appearing 'mid tick' in the field

The current model is sufficiently well developed to meet the needs of the project at this stage, and the enhancements described above promise an even more sophisticated capability over time.

Model Construction

Agents

In our model, agents represent individuals. They have the characteristics of age, sex, labour force status (working or not working), length of time in the community, and number of children ever issued (for women only). The population of agents is constructed based on Census data. Census data is not released for individuals, with the Australian Bureau of Statistics applying a 'confidentialisation' algorithm to data produced through its online database, *Tablebuilder* (www.abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder). The algorithm returns the value of either 3 or 0 for any cell where the actual value is 1, 2 or 3. For small populations such as the communities that are the subject of this research, large numbers of cells will be affected by the algorithm when any more than two or three variables are cross-tabulated. One method to estimate the actual value of a small cell is to repeatedly call the table, and note the changing pattern of 0s and 3s in affected cells. Cell returns which change from 0 to 3 on repeated calls have actual values of 1 or 2. This is a time consuming method. An alternative method is to construct a simulated population, rather than attempt to completely reconstruct the actual Census population. In population simulation, agents with unknown characteristics are assigned those characteristics probabilistically (Rossiter et al. 2009). Known agent characteristics (in our case, age and sex) are used to estimate unknown characteristics based on the attributes of the population as a whole.

An initial table is called from *Tablebuilder* containing age (in single years) and sex (male/female) of the population of interest. The table is extended to a unit record list by creating n copies of table cells according to the cell n value. For example, if the cell 'male, aged 14 years' had a value of 6 (i.e. there were six such individuals in the population), then six 14 year old male agents are created. A script was constructed in Microsoft Excel to automatically identify and extend the initial table.

```
Sub CopyData()
Dim lRow As Long
Dim RepeatFactor As Variant
   lRow = 1
   Do While (Cells(lRow, "A") <> "")
      RepeatFactor = Cells(lRow, "D")
      If ((RepeatFactor > 1) And IsNumeric(RepeatFactor)) Then
         Range(Cells(lRow, "A"), Cells(lRow, "D")).Copy
         Range(Cells(lRow + 1, "A"), Cells(lRow + RepeatFactor - 1, "D")).Select
         Selection.Insert Shift:=xlDown
         lRow = lRow + RepeatFactor - 1
      End If
      lRow = lRow + 1
   Loop
End Sub
```

Additional tables are called for the other characteristics desired in the unit record list:

- age in five year group, sex, labour force status
- age in five year group, sex, labour force status, whether moved to the community in the past five years (indicator of length of time spent in the community)
- age in five year group, female, labour force status, number of children ever born.

Individuals are assigned values for these characteristics probabilistically. For example, if there were 16 females aged between 25 and 29 years who were employed, then 16 unit records for females of this age were selected at random to have the attribute of 'working'. The attributes for length of time spent

in the community and number of children ever born were additionally ascribed based on probabilities of people who were working or not working having those attributes (working women were likely to have had fewer children, for example).

The characteristic of 'length of time in the community' is initially restricted to a value between 0 and 4 years or a value equal to the agent's age. This is because the closest information from the Census is whether the person was resident in the community five years prior to the Census. If individuals were resident five years previously, they are assumed to have been resident for life. In the future, it will be possible to construct 'life tables' of length of time in the community and probabilistically determine how long each agent is likely to have been resident (Bell 1996).

The unit record list ultimately contains the following attributes for each agent:

- age (single year)
- sex (male or female)
- labour force status (working or not working)
- length of time in the community (0, 1, 2, 3, 4 years or the value for 'age')
- number of children ever born (for females only).

The unit record list is saved as a tab separated text file without column headers (see Figure 65).

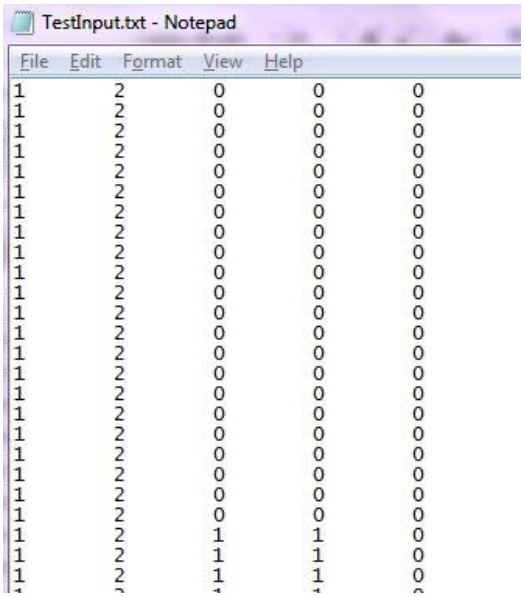


Figure 65 Sample of unit record list

Initial Probabilities

The population changes over time through deaths and out-migration (removing agents from the population) and births and in-migration (adding new agents to the population). Initial probabilities are calculated for death, out-migration and giving birth for each agent in the initial unit record list. A separate 'dummy population' is constructed from which new agents may decide to migrate in to the focus population.

Age specific death rates (annualised) are used to set initial probabilities for death (see Australian Bureau of Statistics catalogue number 33020DO002_2010 Deaths, Australia, 2010). Age specific

death rates are available for each State and Territory. The 'mean' rate is considered to be that applying to the population of the State in which the focus community is located. Information about death rates in other States and Territories is used to estimate likely distribution of actual death rates around the mean value. Separate probability curves are described for infants (age 0), children (aged 1-4 years) and older agents and for males and females in these age groups. For example, in New South Wales in 2006, the estimated death rate for male infants was 5.6 in every 1000 population, and for female infants 3.8 in every 1000 population. Infant death rates are highly variable (and substantially skewed below the mean), so male infant agents in our Waikerie model had a probability of dying in the first year between 0.1% and 0.6%. Death rates for older agents were calculated based on sex and the 'curve' of death rates by age. The curve is expressed as a third order polynomial equation. Table 27 lists the initial death rates for each age/sex class for Waikerie. Figure 66 illustrates the death rate curve for older males and females.

Table 27 Initial death rates for Waikerie

Sex	Age	Low Rate	High Rate
Male	0 years	0.1%	0.6%
Female	0 years	0.1%	0.4%
Male	1-4 years	0.01%	0.03%
Female	1-4 years	0.01%	0.02%
		Curve	
Male	5 years and over	(0.00005 * (age/5) ^ 3) - (0.0008 * (age/5) ^ 2) + (0.0039 * (age/5)) - 0.0045	
Females	5 years and over	(0.00003 * (age/5) ^ 3) - (0.0006 * (age/5) ^ 2) + (0.003 * (age/5)) - 0.0035	

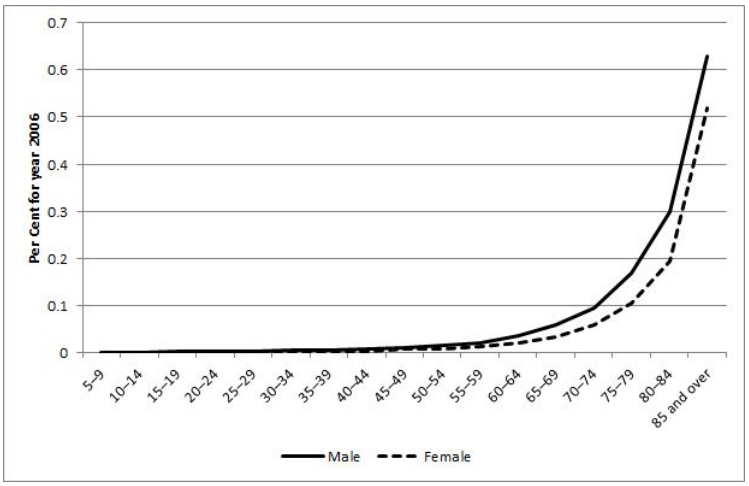


Figure 66 Death rate curves for males and females aged 5 years and over, New South Wales, 2006

Annual age and sex specific out-migration probabilities were derived from observed out-migration from the focus community between 2005 and 2006 and analysis of observed out-migration from 'analogue' populations. Analogue populations were identified by calculating the total out-migration rate 2005 to 2006 for each Statistical Local Area in the 'rural balance' area of Australia (which included our focus communities). The distribution of out-migration rates was divided into quintiles, and 'analogues' for each case study community were drawn from other Statistical Local Areas in the same quintile. The overall out-migration rate for all rural balance Statistical Local Areas 2005 to 2006 was equal to 23.3% of their 2006 population. The standard deviation was 10.3%. St George (35%) was in the highest quintile, and both Waikerie (17.7%) and Gunnedah (19.6%) were in the middle quintile.

Figure 67 broadly illustrates the set of analogue Statistical Local Areas for St George (circled in red) and for the other two case study communities (circled in blue).

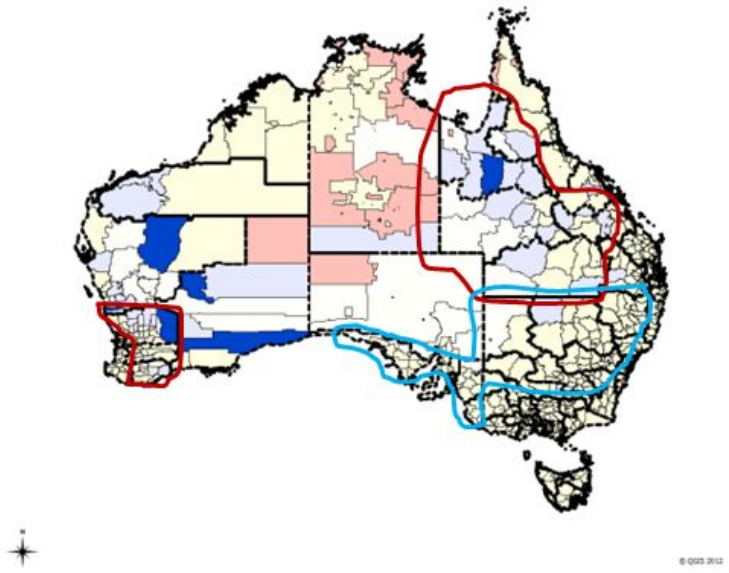


Figure 67 Migration analogue populations

Migration probability curves were constructed for males and females and for ten year age groups (0-9 years old, 10-19 years old etc.). Entering more detailed curves (five year or single year age groups) into the model did not provide substantively different output, and so ten year age groups were selected because of the simplicity of their calculation and the lesser influence of small n cells in the tables used to calculate rates. Initial male out-migration rates for Waikerie were assigned to the curve (0.0035 * (age/10) ^ 3) - (0.052 * (age/10) ^ 2) + (0.1998 * (age/10) - 0.0592. Initial female out-migration rates for Waikerie were assigned to the curve (0.0017 * (age/10) ^ 3) - (0.0267 * (age/10) ^ 2) + (0.1031 * (age/10)) + 0.0339. These are illustrated in Figure 68.

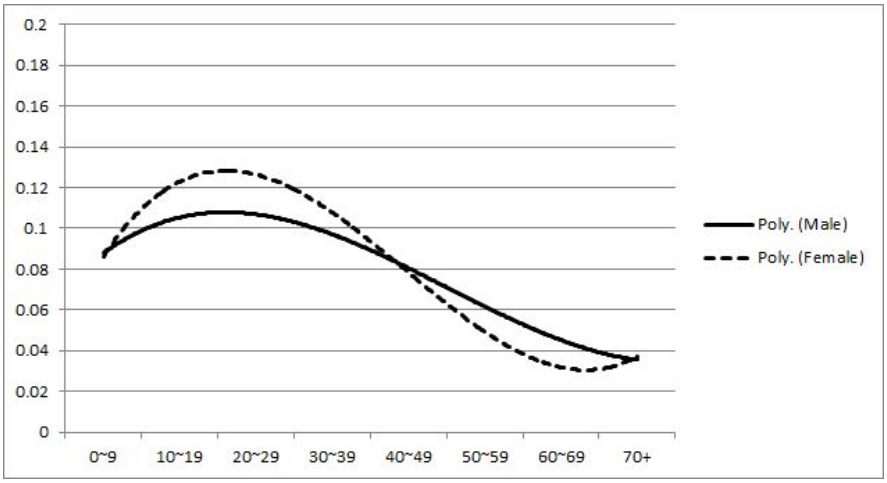


Figure 68 Initial out-migration curves for males and females, Waikerie and analogues 2005-6

Initial birth rates were calculated for females aged between 15 and 44 years of age. Birth rates were derived in the same way as death rates, but using the Australian Bureau of Statistics 'Births, Australia' dataset (catalogue number 33010DO001_2010). Only one curve was needed to set initial probabilities: (-0.0015 * (age/5) ^ 3) - (0.0007 * (age/5) ^ 2) + (0.0694 * (age/5)) - 0.0707. For example, it would be expected that there would be 120 babies born for every 1000 women aged 30-34 years in 2006. A

woman of that age in Waikerie would have an initial probability of giving birth in 2006 of 12%. An additional determinant of probability of giving birth was based on the number of previous children the woman had issued. Based on analysis of analogue data, it was determined that women who had no previous children were slightly less likely to have a child than women with one previous child. Women with two or three children were less likely to have further issue. These probabilities were described by the second order polynomial curve: 0.0214 * children ^ 2 - 0.2986 * children + 1.09.

Previous mention has been made of the difficulty of describing the potential for in-migration to the focus population. For the purposes of this model, we created 'dummy' populations with the in-migration probabilities applying to the analogue Statistical Local Areas for each case study community. The 'dummy' populations were replicas of the resident population, and in-migration was simulated by members of the dummy population 'reproducing' according to their age and sex and probability that someone of that age and sex migrated in to an analogue community between 2005 and 2006. As with out-migration probabilities, ten year age classes were sufficient.

Model Operation

The complete code for the baseline agent based model for Waikerie (i.e. what would happen to the population between 2006 and 2025 if the initial probabilities of the various demographic events persisted throughout) is attached as an appendix. In summary, the model operates as described in Figure 69. The model begins by defining the variables to be used (including the characteristics in the unit record list and the various probabilities described above). It then calls up the unit record list and populates the field accordingly. Each agent is given its own area within the field, and is given characteristics reflecting its age (individuals aged less than 15 years are smaller than older individuals) and sex (males are blue, females are red). For each run of the model (representing one year), agents cycle through the demographic events of giving birth, dying, or out-migrating, and the dummy population enacts the event of in-migration. Within each event, each agent is randomly given a value between 0 and 1, and if that value is smaller than the minimum value required to enact the event, the agent does so. For example, if a 26 year old female retrieves a value less than 0.22 within the out-migration event, she is asked to leave the population.

At the end of the run, graphs are produced showing the total population and the age distribution (ten year age groups). Output is also provided describing median age, the percentage of people aged under 15 years in the population, the percentage of people aged over 64 years in the population, the percentage of males in the population and the total population count. At the commencement of the next run, agents are aged by one year (affecting their probabilities accordingly) and their number of years in the community increases by one year (which can also affect probabilities). The model can be run for any length of time, but is typically set to run for fifteen or twenty years.

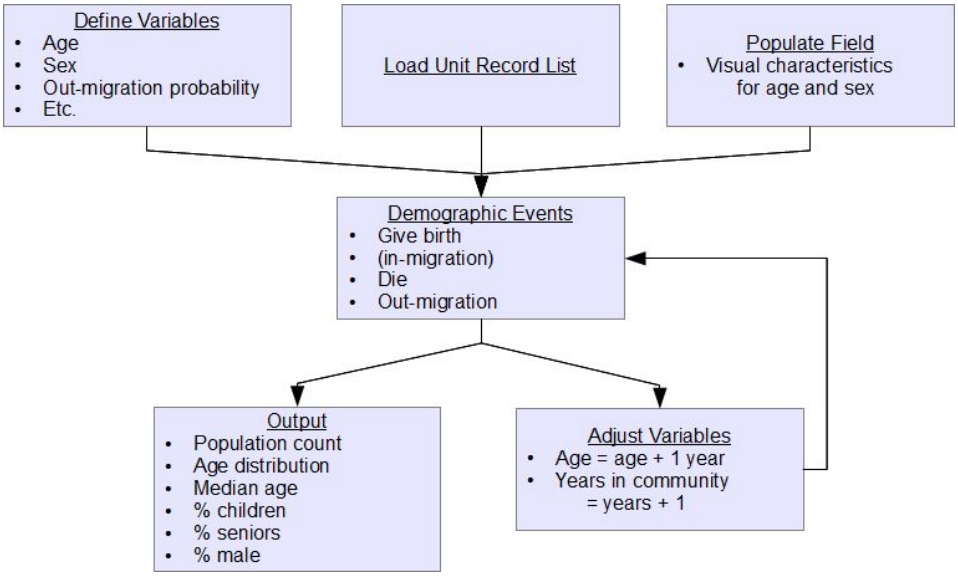


Figure 69 Model operation

Integration

The processes described above allow the model to examine the progression of the population under the assumption that the pattern of demographic events observed in the period 2001 to 2006 persists through the lifetime of the model. The real value of the model is to examine alternative scenarios. Those scenarios, and the impact they may have on demographic events (meaning migration events, given the previous discussion about the lack of impact of all but the most dramatic changes in birth and death rates on small populations), are drawn from other components of the *Securing the Wealth and Wellbeing of Rural Communities* project (see Figure 70). In particular, the key informant interviews ('inside knowledge') and the community survey ('scenario test') provide the project with the scenarios of interest to the community, and ask how (out) migration behaviour might change under various scenarios. The choice modelling tool ('modelling') calculates out-migration probabilities for individual scenarios and combinations of scenarios for each individual in the population, and these can be grouped by the same age and sex classes as are used in the demographic model.

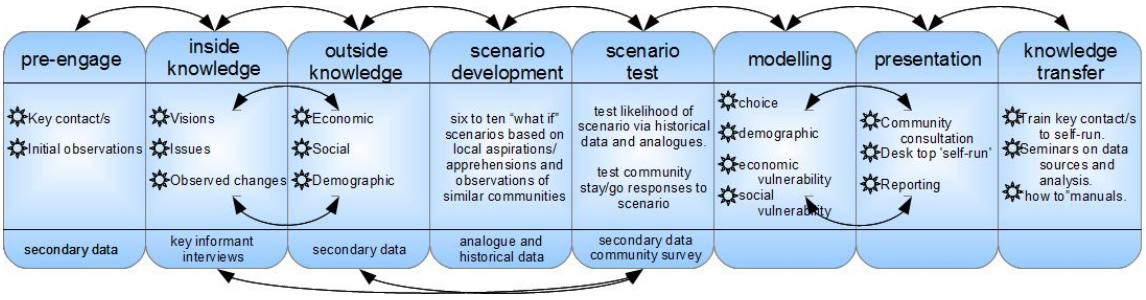


Figure 70 Securing the wealth and wellbeing of rural communities overall project flow

It is well known that individuals have imperfect knowledge of their own future migration behaviour (Lu 1999). In general, people have very good knowledge of what they might do in the immediate future (encompassing one or two years) and less perfect knowledge beyond that. We were able to test the how well the population of respondents to the community survey (conducted in early 2012) who planned to out-migrate under a 'no change' scenario matched the actual out-migration behaviours from that community observed at the 2006 and 2011 Census. Comparison was made using five year out-migration data (i.e. the proportion of males and females of various ages who had left the community between 2001 and 2006 and between 2006 and 2011). Five year data were preferred to one year data because of the timeframes that might apply to realising people's intentions to out-migrate. A current statement of intention may imply out-migration in the following 1-5 years. A summary of the results

of this analysis, for the Waikerie population and for males and females aged between 15 and 74 years, is presented in Figure 71.

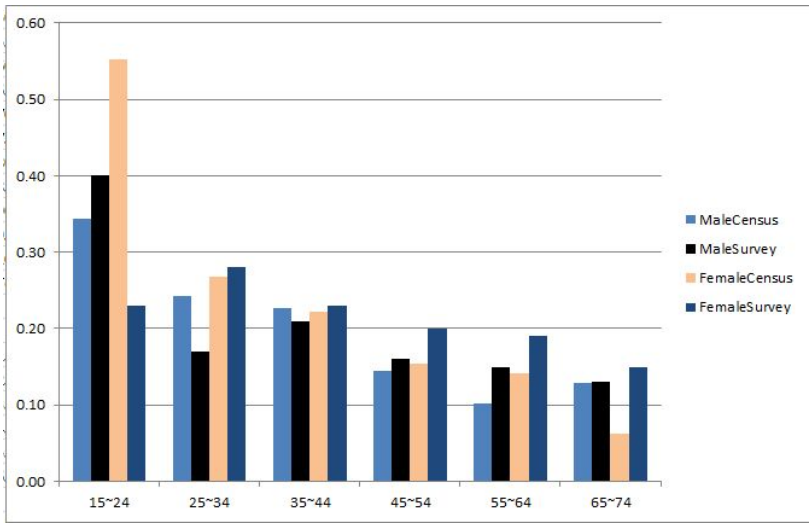


Figure 71 Comparison of observed and anticipated out-migration rates for Waikerie under a 'no change' scenario

Observed out-migration was much higher for the youngest female age class than expected (survey derived) out-migration. The same was the case for male out-migration in the 25 to 34 year age class. Expected out-migration was much higher for females aged 45 years or over, and for males aged 55 to 64 years. Overall, however, there was a reasonable match between expected and observed out-migration. Younger populations may be more mobile than they expect because of the lure of the city (for education and variety of employment) (Halpern 2012). Older populations may be somewhat less mobile than they expect because of the stickiness associated with entrenched working patterns, home and business ownership, social and family commitments and so on (Ellickson 2012). There may also be an impact on out-migration rates over the following five years of the mobility of in-migrants to the community during that period. In short, people who migrate in to a population are more likely to subsequently migrate out of the population than those who have stayed for the total period (Frieze et al. 2006). Consequently, our demographic model draws not only on the survey responses for particular scenarios, but tempers these with our knowledge of previous migration patterns (applying to the case study community and its analogues) and the data in the model about how long each agent has been living in the community.

The use of variants of standard programming languages (Logo and SQL) in the demographic model allows output from the choice model to be easily imported into the demographic model (that output being expected migration behaviour for specific age and sex classes, for example), and for output from the demographic model to be returned to the choice model (mainly for the purposes of summarising and displaying results).

Model Execution and Examination

The Waikerie demographic model was executed in detail for three scenarios: 'no change', closure of the hospital, and increase in tourism activity. The latter two will be described in some detail here. The 'no change' scenario was used to evaluate the performance of the model with respect to the population projections for Waikerie produced by the Australian Bureau of Statistics. Those projections essentially assume that past patterns of behaviour will persist. The 'no change' model consistently produced estimates within 5% of the Australian Bureau of Statistics projections for 20 years (2007-2026). Under the no change scenario, the Waikerie population declined by 400-500 people over the period, aged by nearly 12 years, and had a substantially lower proportion of children (see Figure 72 for a typical output from the no change model).

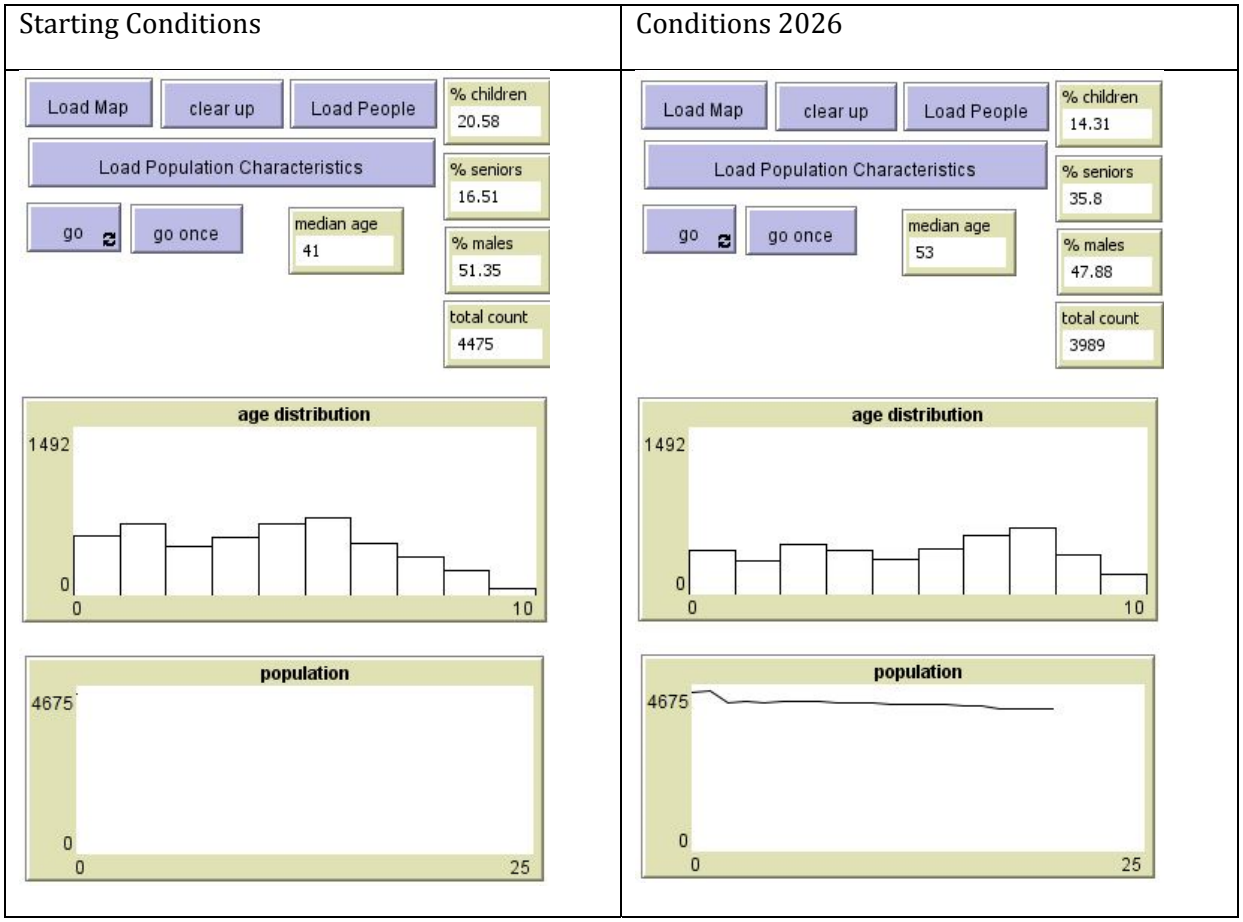


Figure 72 Typical output for a 'no change' scenario in Waikerie

The hospital closure scenario produced the most dramatic increases in expectations of out-migration among all age and sex classes in Waikerie. For example, under a 'no change' scenario, about 17% of males aged 25 to 34 years expected to leave Waikerie, but the rate increased to 35% under the hospital closure scenario. For females aged 65 to 74 years, the out-migration expectation increased from 15% (no change) to 25% (hospital closure). Figure 73 compares the typical 'no change' scenario model run with a typical 'hospital closure' run.

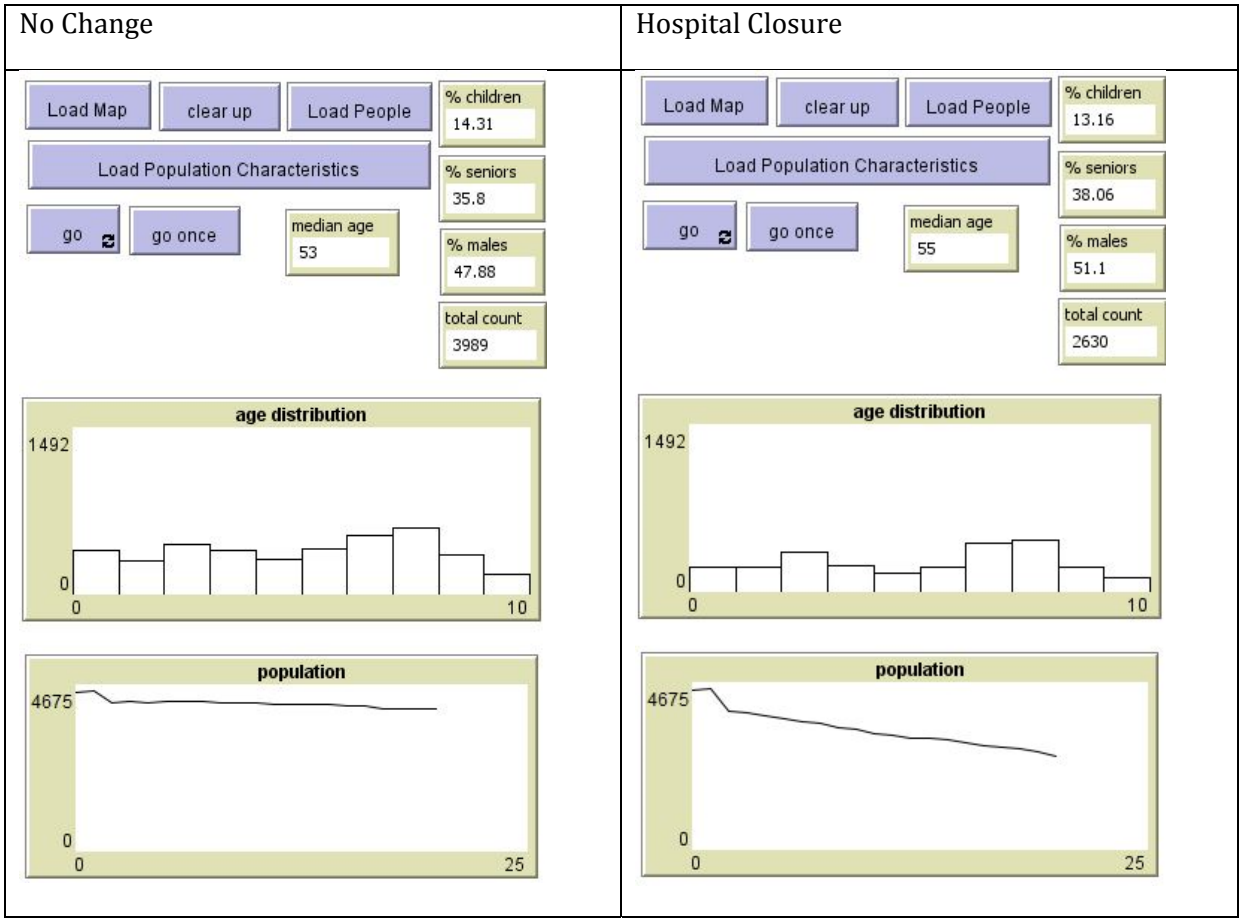


Figure 73 Comparison of typical 'no change' and typical 'hospital closure' scenarios

Population loss is far greater (approaching 2000 people), while ageing is similar. The population at the end of the period is more male, reflecting both an increased out-migration of females and a failure of new females to in-migrate[5]. The substantial immediate population loss reflects the nature of the input data – a relatively large proportion of people saying they will leave the community will do so in a relatively short timeframe (the next year or two). Once these people have left, subsequent departures will be less dramatic[6]. Ageing patterns are relatively similar under no change and hospital closure scenarios in part because older people have fewer resources to leave, and because some continued in-migration of older people looking for more affordable housing (in full awareness of the absence of a local hospital) can be expected to occur.

The model can also be analysed over a number of runs to examine how variable the results of the scenario may be. We ran the hospital closure model fifty times to illustrate this, but a full experiment may consist of 1000 or more runs so that statistics of central tendency can be more reliably calculated. 'Outliers' may be subsumed within summary analysis of means and standard deviations (which we have done to produce the 'typical' runs shown in Figure 72 and Figure 73), or they can be analysed individually to propose why they might have occurred.

[5] For the purposes of this modelling, in-migration rates were dynamically adjusted as a function of the changed nature of the 'dummy' population. Therefore, as the number of (for example) females aged in their 30s in the resident population decreased, their potential to be 'replicated' in the in-migrant population similarly decreased.

[6] Note that there is a relatively large immediate loss in the 'no change' scenario as well. This also reflects the likely behaviour of survey respondents planning to leave, and also the weakness of the model with regards to simulating in-migration. In-migration rates for the 'dummy' population are smoothed over the entire period.

The fifty runs experiment revealed relatively little variability in the results of the hospital closure scenario (see Figure 74). This reflects the significance of this scenario to the Waikerie community. The mean end of run population was 2560 people, with a standard deviation across the fifty runs of just 96 people (or 4% of the end population).

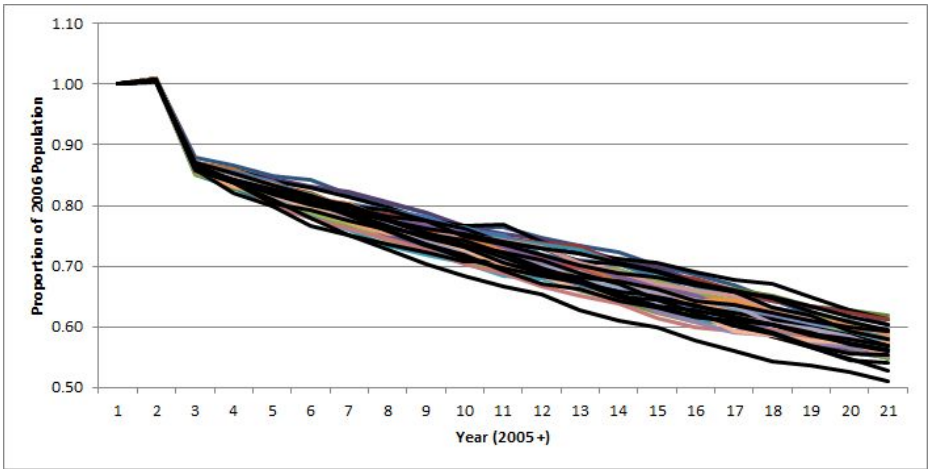


Figure 74 Total population change under hospital closure scenario – fifty model runs

The increased tourism scenario produced relatively small changes in out-migration expectations. For example, out-migration expectations among males aged 35 to 44 years declined by less than 1%. Changes in rates were similar for young women, who may be expected to benefit most in terms of generation of new jobs in tourism and hospitality (Zampoukos and Ioannides 2011). Another group expected to benefit from increased tourism in a town like Waikerie would be pre-retirement and early retirement aged people who might be enticed to operate 'lifestyle' tourism businesses such as bed and breakfast accommodation, cafes, and tours (Thomas et al. 2011). The out-migration expectations of this age group were also only marginally affected by the increased tourism scenario. There may therefore be a limited capacity for the existing population to respond to increased tourism. This implies that population growth (or arrest of decline) under an increased tourism scenario will be reliant on changing patterns of in-migration rather than out-migration. This is an important issue for the Waikerie community to consider[7], demonstrating the value of the model in stimulating public debate about various 'wealth and wellbeing' scenarios. It also highlights the need to develop a more sophisticated method for simulating in-migration than is in the current model.

Figure 75 compares a 'typical' increased tourism run with the typical 'no change' run. Figure 76 describes a fifty run experiment of the increased tourism scenario. The mean end population was 3850, with a standard deviation of over 100. Population decline over the entire period was therefore similar to that expected under the 'no change' scenario, further reinforcing the need for assessment of this scenario as described in the paragraph above. There were slight differences expected in terms of population ageing (which would be less severe under the increased tourism scenario) and continuing gender balance (there would be a slightly higher percentage of women in the population under the increase tourism scenario). There were also some runs where population actually grew in the short term (when accounting for the immediate out-migration effect previously described). This may indicate that tourism can be a short term adjustment strategy, but is more difficult to sustain as a growth sector over time (Huh and Vogt 2008). The differences in the early trajectories in Figure 76 can be accounted for by variations in out-migration rates of young females. As fewer young females leave, the community is more attractive for young males, and there is increased probability of children being born in to the population. However, out-migration rates among young people then increase as they have (potentially through the flexible engagement in the labour force offered by the tourism

[7] Researchers Carson and Carson presented a public seminar on this and related tourism issues in Waikerie on 12 February, 2013.

sector) more resources to out-migrate (particularly for education) after a short length of time (typically three to five years).

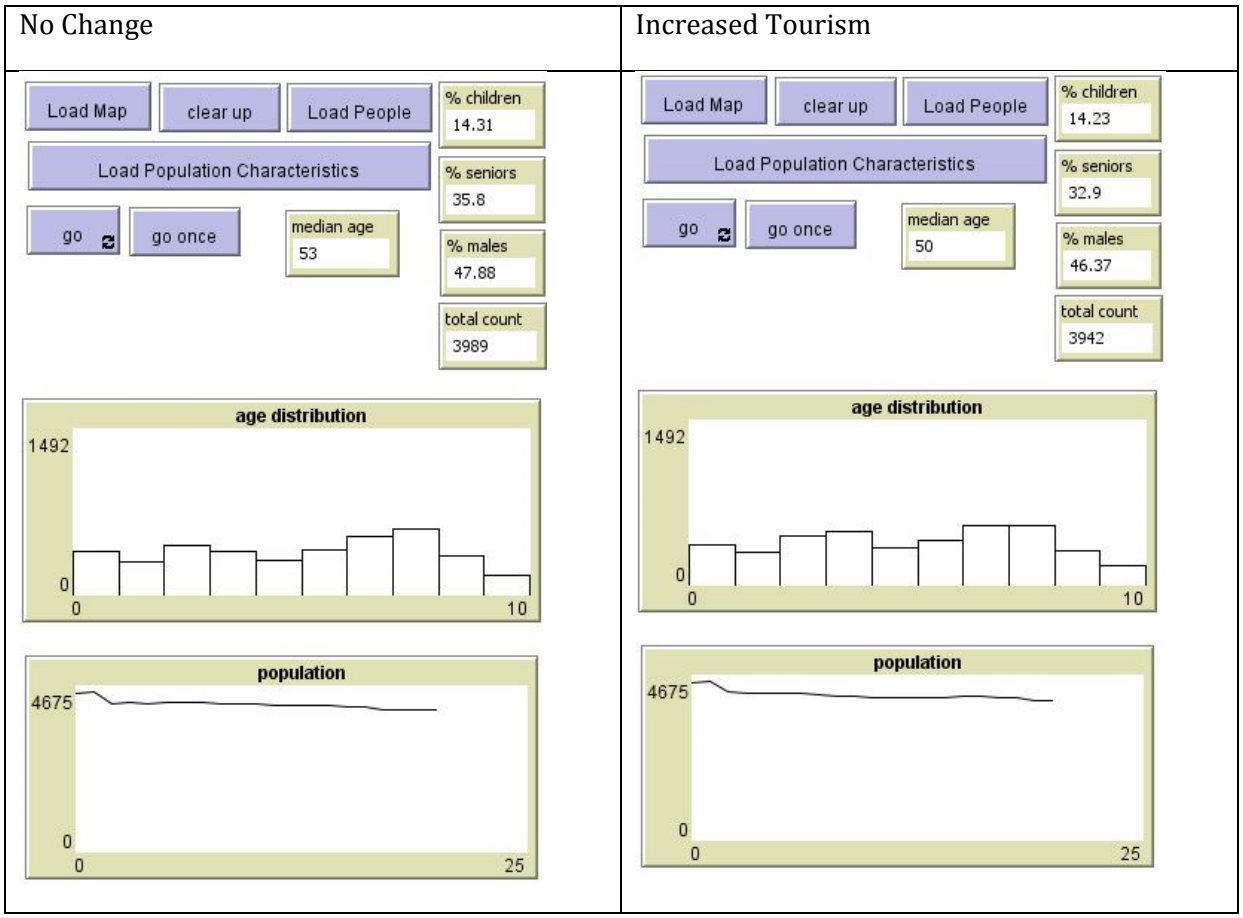


Figure 75 Comparison of typical 'no change' and typical 'increased tourism' scenarios

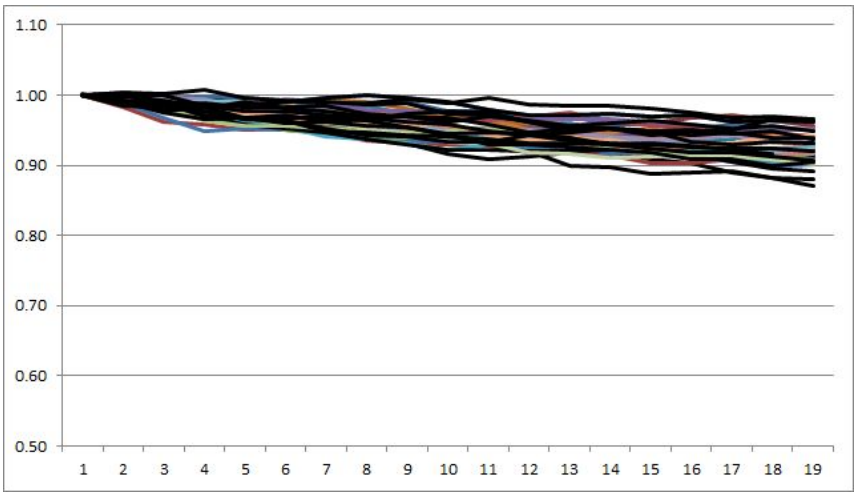


Figure 76 Total population change under increased tourism scenario – fifty model runs

An interesting outcome of the community survey in Waikerie is that 'negative' scenarios tended to have more dramatic and predictable effects in terms of increasing expectation of out-migration than 'positive' scenarios had on decreasing expectation of out-migration. This may be in part due to the nature of the scenarios selected for examination in the survey (it may be argued that negative scenarios were more concrete than positive ones), the level of concern survey participants had for their community's future, and the stickiness of out-migration patterns. The 'path dependency' of Waikerie's

population trajectory up to 2006 is consequently a possible explanation for the relatively limited long term impact of the increased tourism scenario.

Conclusions and Further Development

The demographic modelling for the *Securing the Wealth and Wellbeing of Rural Communities* project is designed to be underpinned by, and to facilitate, a 'demographic discussion' with communities. Community aspirations and apprehensions for the future are often couched in demographic terms related both to gross population change and specific types of population change. The baseline demographic analysis allows the project to explore the context in which scenarios identified by the community as important to their future might occur. It provides a method for testing the responses to the community survey (specifically responses relating to out-migration intentions) and it 'fills the gaps' in survey information by assessing patterns of in-migration, births and deaths. At least as important as all these functions is the demographic modelling as a contribution to the community from the project. The experience in Waikerie highlighted the value that community members attach to having existing social and demographic data about them interpreted in the context of their aspirations and apprehensions.

The agent based demographic model converts the raw outcomes of the community survey into simulations of what the community might look like five, ten, fifteen or twenty years into the future. Those simulations in turn provide input to community discussions around specific scenarios and how they may be used to promote community wealth and wellbeing. The project has not yet progressed to assisting communities to use this information in their negotiations with government and other external stakeholders, but that is clearly an important next step. In Waikerie, for example, the community could use the 'hospital closure' scenario in negotiations around what the regional health system might look like into the future.

Along with realising a process through which communities can extend the demographic discussion to external agencies, the project needs to continue to develop in regards to the demographic modelling:

- ensuring that the community survey and choice model explore more concrete (and more positive as well as negative) scenarios, potentially improving participants' competence in assessing their migration responses
- creating a more realistic in-migration simulation method
- more sophisticated use of key associated variables (labour force status, length of time in the community, but also potentially marital status, housing tenure and other variables) in determining individual demographic probabilities
- more sophisticated mechanisms through which agents influence one another (creating family and social networks for example)
- a method to simulate the impacts of short-term populations (such as tourists or seasonal farm workers in the case of Waikerie) on demographic change
- seamless integration of the demographic model with the choice model both to enable construction of scenarios on the fly (using data from the choice model to automatically adjust out-migration curves, for example) and to push through output (the various charts and calculations) to the choice model interface.

Chapter 6 - Issues impacting on the sustainability of rural communities

Authors: Anthony Hogan, Robert Tanton, Itismita Mohanty, Pele Cannon, Sarah May, Stewart Lockie, David Donnelly. Eric Wu and Jeremy Cape

Introduction

Significant change is occurring in rural and regional Australia, particularly in eastern Australia. Much of rural and regional Australia has only recently emerged from a ten year drought which affected communities right across the Murray-Darling Basin (see Figure 77). The drought impacted not just on the viability of agriculture and rural towns (for example Goulburn) but on the viability of many river systems and the eco-systems which they support. The significance of the drought catalysed a policy re-think on the use of irrigated water for industry, taking into account climate change. The result of this policy work has been the development of the Murray-Darling Basin Plan (Murray-Darling Basin Authority 2012), which included several early consultative drafts. The initial proposed plan was seen to threaten the viability of a variety of agricultural industries and the communities which depend on such industries for their livelihoods. Various statistical models were put forward which presented the likely impacts of the Plan on various rural communities (Marsden Jacob Associates 2010b: Stubbs et al. 2010). In addition to addressing the economic impacts of the Basin Plan, some of these studies also began to address the social impacts of policy and environmental change. The findings of some of the studies were strongly contested within the community and the scientific community. Similarly some of the engagement processes that had been initiated exacerbated tensions within the sector.

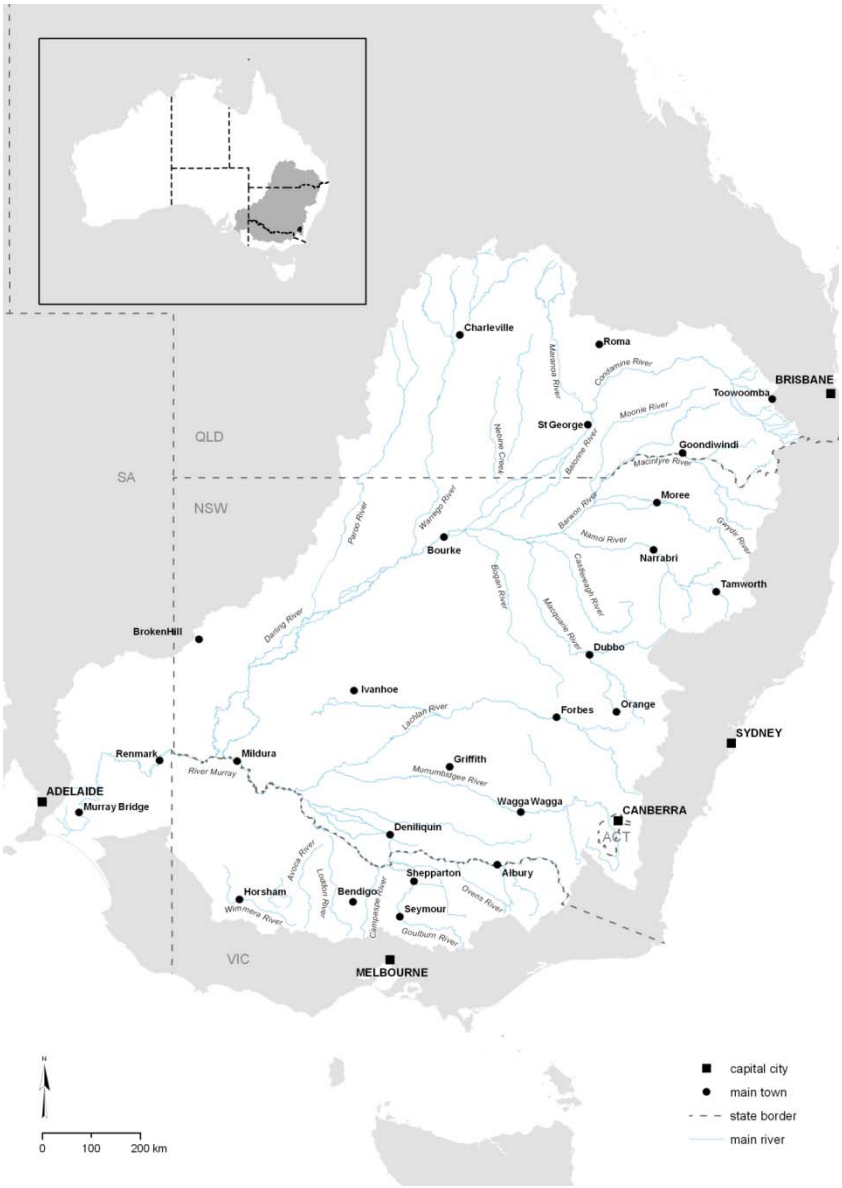


Figure 77 The Murray-Darling Basin

While there was much debate about the meaning and impact of a Basin Plan at a national level, issues also began to percolate at the local level. It rapidly became apparent that specific communities did not have access to the data they needed to inform their decisions. While data existed, it was not in a useable form or the data was not produced by a trusted source. Within a contested policy space, any of these issues served as a significant barrier to effective engagement.

At the same time the Cotton Communities Collaborative Research Centre had convened the first of three community conferences which were concerned with the question of the sustainability of rural communities. The issue of the accessibility and useability of local level data arose at this conference. At the same time, analysis commissioned by the Namoi Catchment Management Authority (Namoi CMA) identified that adaptive capacity and social wellbeing were critical factors which impacted on important environmental processes across their catchment area (Cork et al. 2011).

It was from within the intersection of these quite distinct processes that the need for this project was born. Communities were seeking information that they could use to inform their participation in policy

development processes. To sustain themselves, stakeholders saw that rural communities were increasingly faced with the need to constantly adapt in the face of change, be that change driven by competitive economic pressures demanding ever greater productivity, globalism, technology development or climate change. Adaptation which secured socioeconomic viability and environmentally sustainability in the face of constant change, meant that communities required an adaptive capacity that involved the presence of community development and environmental values, the human ability to engage in change, and a viable local economic base which had sufficient flow on values and job generation capacity. Inherently, communities would possess these attributes to differing degrees. However, what was noticeably absent was the opportunity for communities to readily assess where they stood in relation to these attributes and how any specific proposed development or devolution of their economic or environmental base, may impact on their community and their wellbeing or vice-versa.

To this end this project examined four aspects of adaptability which may impact on the sustainability of rural communities: (i) individual and collective adaptive capacity (ii) social wellbeing (iii) natural resource condition and water sharing, and (iv) factors which might drive people to leave their community. Additional studies conducted in conjunction with this work address the role of community leadership in supporting adaptation in the face of change (Carson & Cleary 2012), the structure of the main economic flows which underpin the viability of livelihoods within these communities (Houghton & Fell 2012), demographic projections (Carson et al 2012) and homeostatic failure in human wellbeing (Tanton et al. 2012). This monograph reports on a series of studies which were designed to examine these issues within the applied context of three rural communities: Waikerie (near Renmark in the South Australian Riverlands), the Namoi (in far west New South Wales centring on Narrabri) and the Balonne Shire (St George, Queensland). These are three very distinct rural communities. The selection of these communities was determined, in the first instance, by funding bodies which were based in the Namoi and in cotton communities. This led to the selection of the Namoi area as a primary site for the study. Two comparative sties were also sought, one with a similar industry (cotton) base to the Namoi, but also one community which was distinctly not involved in cotton production. The St George area in southern Queensland is supported by a substantive cotton industry, as well as cattle and sheep industries. Waikerie, in the Riverlands in South Australia, is a community whose local industries are primarily citrus and grapes. The main towns in each of the study sites have the distinctive feature of having a major river running through it and in each area, irrigation is used in production processes.

This report commences with an examination of the question of the adaptive capacity of people in rural communities in relationship to human wellbeing. In the face of climate change environmental outcomes are increasingly recognised as being central to the question of the sustainability of rural communities. The sections on ‘Vulnerability, adaptive capacity and wellbeing’ and ‘Perceptions of natural resource condition and human wellbeing’ take up this question and examine first, community attitudes towards critical questions such as natural resource condition and water sharing before considering the extent to which a relationship may exist between natural resource condition and the wellbeing of community members.

A key tenet held by the working group which undertook these studies, is John Martin’s (La Trobe University) insight that ‘if you’ve seen one rural town; you’ve seen just one rural town!’ In the section on ‘Recognising diversity within the adaptive capacity of rural communities’ we examine differences in these rural communities by comparing them on the indicators considered in this study, specifically individual and collective adaptive capacity, social connectivity, community leadership, and wellbeing.

A critical issue impacting on the viability of rural communities is population drift. In the section on ‘How rural communities may be affected by changes in the availability of services’ we take up this issue by examining, from a community perspective, the issues which community members regard as being central to their continuing to live in their communities.

Research methods

This chapter provides a brief overview of the research methods which underpin this study. A full report of the method can be found in Appendix 2. The study involved a two-staged methodology. Stage I of the study involved a 20 minute computer aided telephone interview (CATI) survey of 2000 respondents from across the three areas of interest; Namoi, Riverland and St George areas. The main components of the survey were:

1. subjective wellbeing (Cummins 2009)
2. basic index of recent stressful events
3. financial and emotional impacts of significant weather events
4. questions on individual adaptive capacity (Schwarzer & Jerusalem 1995) ,
5. questions on collective adaptive capacity including community leadership (Paton, Burgett and Prior 2008)
6. social connectedness (The Centre for Bhutan Studies 2012; McIntosh et al. 2008; Cummins et al. 2003; Salvaris 2000)
7. work life balance (Karasek 1979)
8. state of natural resource condition (Namoi Catchment Management Authority 2007)
9. water usage (Namoi Catchment Management Authority 2007)
10. demographic items
11. a discrete choice model which examined a series of six possible rural scenarios. Residents were asked to decide on the basis of scenarios, whether or not they would stay in or leave the community.

A copy of the survey instrument can be found in Appendix 3 of this report.

Sampling and data collection

The sampling frame for the study was based upon previous research designs used for Namoi Catchment Management Authority (CMA) projects (see for example Ipsos 2007, 2010). These research designs recognised the role of key stakeholder groups within the rural community (primary producers, hobby farmers, town residents and change agents), particularly with regards to community involvement in natural resource management. The Namoi CMA was a major supporter of this study and requested that the research design used in this study be consistent with their earlier designs. To this end the sampling for this study was structured to capture the range of views of these stakeholders with regards adaptability and change in the face of changing climate, water policy and the viability of family farming in agri-dependent communities. The telephone survey then drew 2,000 people covering the key target audiences on the following basis:

- primary producers/natural resource managers n=400 (Source: a list representing the primary producer and natural resource manager population)
- community – town dwellers n=1000 (Source: random digit dialling)
- community – rural dwellers n=500 (Source: random digit dialling)
- change agents - n= 100 (Sample: sourced from a list).

For the purposes of this study hobby farmers were defined as people living on a small area property outside of town boundaries and whose land holding and scale of enterprise were not large enough to qualify them as a primary producer. Sampling of these households was split equally between male and females.

For the purposes of this study change agents were defined as people engaged in servicing primary producers and land managers through commercial services such as contracting, consulting and sale of goods as well as state, federal and local government employees providing information and advisory services to land managers. For this sample, no quotas were set on gender.

The figure below provides data on the final sample design.

Namoi Catchment area

LGA	Primary producers		Town residents		Hobby Farmers		Change Agents		Total	
	No	Percent	No	Percent	No	Percent	No	Percent	No	Percent
Tamworth incl Walcha	75	30%	330	60%	60	60%	60	60%	600	60%
Gunnedah Warrumbungles	63	25%	83	15%	15	15%	15	15%	150	15%
Liverpool Plains	38	15%	44	8%	8	8%	8	8%	80	8%
Narrabri	63	25%	77	14%	14	14%	14	14%	140	14%
Walgett	13	5%	17	3%	3	3%	3	3%	30	3%
Total	250	25%	550	55%	100	10%	100	10%	1000	100%

And in the St Georges and Waikerie area:

	Primary producers	Town residents	Hobby Farmers	Change agents	Total
St George	100	250	125	25	500
Waikerie	100	250	125	25	500

11

Figure 78 Sampling frame for this study

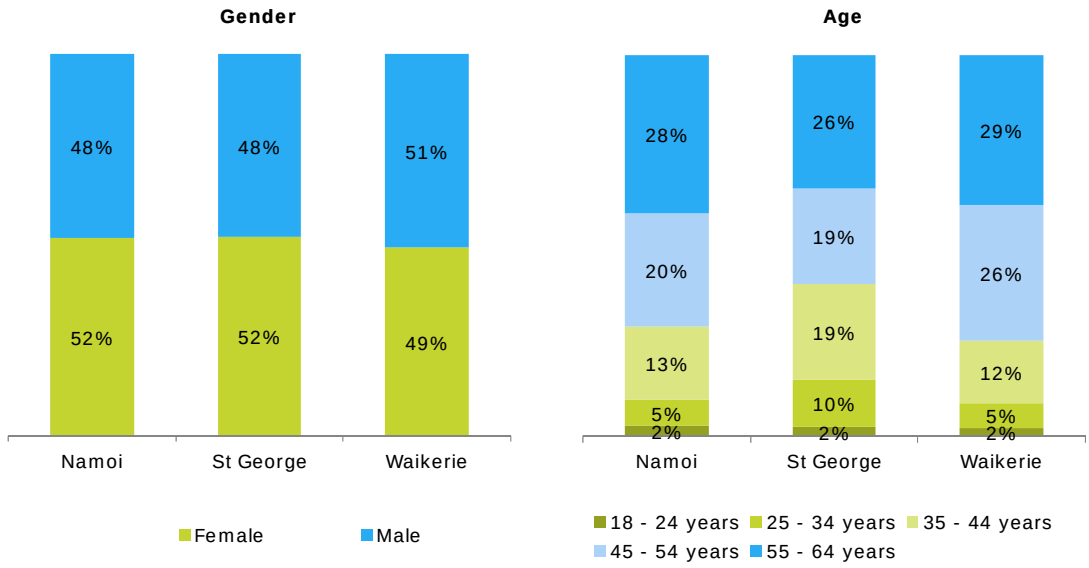
The figure below reports on the actual sample obtained. As is evident from the table, some minor oversampling occurred in St George (n=657) and Waikerie (n=525). This occurred as a result of the process of random digit dialling which was utilised in this study. Within this design the first four digits of the telephone number are held constant, to capture residents in a given area, while the last four digits are randomly dialled to capture households within the targeted area. As a result of increasing centralisation of telephone systems in rural areas, numbers with the same leading four digits may in fact capture residents from both the targeted community and those in neighbouring areas. This outcome occurred in this study.

	N = 2196	%
Namoi		**46**
Tamworth incl Walcha		24
Gunnedah Warrumbungles		8
Liverpool Plains		4
Narrabri		8
Walgett		2
St George		**30**
St George		23
Outside of St George		7*
Waikerie		**24**

Figure 2 Sample captured for this survey

Eligible participating respondents were people aged 18 – 74 years. The figure below provides basic demographic data for the respondents. The age profile of the sample is skewed towards the older age group, reflecting the known age profile of rural communities (Hogan et al. 2008).

On these respondents, 740 agreed to complete the choice model survey.



16 *Base: Total Sample - Namoi (n=1014), St George (n=657*), Waikerie (n=525)*
** Includes additional sample*

Figure 79 Survey participants by gender and age

The figure below provides data on the employment status of respondents.

		Namoi (n=1014) %	St George (n=657*) %	Waikerie (n=525) %
Employment situation	Self employed	26	38	23
	Employed for wages, salary or payment in kind	32	33	35
	Unemployed and looking for work	2	1	1
	Engaged in home duties	3	3	2
	Full time student	0	0	0
	Retired	32	20	32
	Unable to work (not due to age)	5	4	5
	Other	1	1	2
Working group		Namoi (n=588) %	St George (n=463*) %	Waikerie (n=308) %
Type of work	Full time	69	75	58
	Part time	22	17	24
	Causal	7	7	13
	Contract	2	1	5

** Includes additional sample*

Figure 80 Employment status of survey participants

Data management

Indices and indicators derived from the survey

Two indices (wellbeing and stress) and seven indicators were derived from the survey items. The two indices were:

1. the Deakin Wellbeing Index (Cummins et al. 2002)
2. an index of cumulative life stresses made up of items such as experiencing a natural disaster in the past 12 months.

The seven indicators were:

1. individual adaptive capacity e.g. I can solve most problems if I invest the necessary effort
2. ability to work together (collective adaptive capacity) e.g. The people in this community can work together even when it requires more than normal effort
3. community connectivity e.g. I always feel that I am an important part of this community
4. access to social support e.g. I am able to get support from family and friends when needed
5. efficacy of community leadership e.g. our local Council is very effective in planning for our community
6. perceptions of natural resource condition e.g. There are enough shrubs and grasslands in the region to support native birds, animals and plants

7. perceived importance of water for the environment e.g. provision of water for the environment is equally as important as provision of water for agriculture, towns and industry.

Table 28 below reports the items make up the Deakin Wellbeing Index. The index is scored between 0-10 and mean scores of 7.5 are generally found in population surveys. Scores below 6 are considered to be of concern (see Appendix 2 and also Tanton et al. 2012).

Table 28 Items loading on the Deakin Wellbeing Index

	Item
Deakin wellbeing Index	Satisfied with life as a whole
	Satisfied with your standard of living
	Satisfied with what you are currently achieving in life
	Satisfied with your future security
	Satisfied with your health
	Satisfied with feeling part of the community
	Satisfied with your personal relationships
	Satisfied with how safe you feel

Table 29 below reports the items which make up the cumulative stress index. The index is scored from 0 through 8 and is calculated as the sum of major stressful life events having been experienced in the last 12 months.

Table 29 Items making up the Cumulative Stress Index

	Item
Cumulative Stress Index	Experienced a natural disaster
	Were in a fire or explosion
	Were in a transportation accident (e.g. car accident, boat accident, train wreck, plane crash)
	Had a serious accident at work, home, or during recreational activity
	Were assaulted
	Experienced a life-threatening illness or injury
	Someone close to you died
	A child was born into your family

Table 30 below reports the items which make up the indicator for Individual Adaptive Capacity. Within the analysis this indicator was scored on a scale of 1 to 5 where scores of 3 indicate that individuals concerned considered that they had the capacity to solve the problems which they confronted at the time of completing the survey.

Table 30 Items loading on the indicator for individual adaptive capacity

	Item
Individual adaptive capacity	I can solve most problems if I invest the necessary time
	Thanks to my resourcefulness, I can handle unforeseen situations.
	I can handle whatever comes my way
	When I am confronted with a problem, I can usually find several solutions
	I can always manage to solve difficult problems if I try hard enough

Table 31 below reports the items which made up the indicator for Collective Adaptive Capacity (ability to work together). Within the analysis this indicator was scored on a scale of 1 to 5 where scores of 3 indicate that individuals concerned considered that their community had the capacity to solve the problems which they confronted at the time of completing the survey.

Table 31 Items loading on the indicator for collective adaptive capacity - ability to work together

	Item
Ability to work together	The people in this community can work together even when it requires more effort than normal
	The community can present a united vision to outsiders
	We can resolve crises in this community without any negative after effects
	Our community can co-operate in the face of difficulties to improve the quality of community facilities
	The members of this community talk about issues they are interested in

Table 32 below reports the items which made up the indicator for Collective Adaptive Capacity (community leadership). Within the analysis this indicator was scored on a scale of 1 to 5 where scores of 3 indicate that individuals concerned considered that they leadership was strong or effective at the time of completing the survey.

Table 32 Items loading on the indicator for collective adaptive capacity - Community leadership

	Item
Community leadership	Our local council is very effective in planning for our community
	Our community has a strong leader who would lead us through significant changes e.g. climate variability and drought, global economic, and industry change

Table 33 below reports the items which made up the indicator for community connectivity. Within the analysis this indicator was scored on a scale of 1 to 5 where scores of 3 indicate that individuals concerned reported that they felt safe at the time of completing the survey.

Table 33 Items loading on the indicator for social capital – community connectivity

	Item
Community connectivity	I always feel I am an important part of this community
	Most people in this community can be trusted
	This community accepts people from different cultures and backgrounds
	I have opportunities to participate in affordable local arts & cultural activities if I want to

Table 34 below reports the items which made up the indicator for Social Capital (social support). Within the analysis this indicator was scored on a scale of 1 to 5 where scores of 3 indicate that individuals concerned considered that had to draw on from family and others within their community.

Table 34 Items loading on the indicator for social capital – support in the community

	Item
Social support	I am able to get support from family and friends when needed
	If I could not drive I would be able to get to the nearest major regional centre using other means e.g. public transports, friends and family members

Table 35 below reports the items which made up the indicator of Perceptions of Natural Resource Condition. Within the analysis this indicator was scored on a scale of 1 to 5 where scores of 3 indicate that individuals concerned considered that there were positive biodiversity outcomes in their area.

Table 35 Items loading on the indicator for perceptions of natural resource condition

	Item
Perceptions of natural resource condition	There are enough shrubs and grasslands in the region to support native birds, animals and plants
	There are enough trees in the regional landscape to provide sufficient food and shelter for native plants and animals
	Sufficient resources have been allocated to protect endangered plant and animal species in this area

Table 36 below reports the items which loaded onto the indicator of Perceptions of Support for Water for the Environment. Within the analysis this indicator was scored on a scale of 1 to 5 where scores of 3 indicate that individuals concerned supported the use of water for the environment as well as towns and industry.

Table 36 Items loading on the indicator for perceptions of importance of water for the environment

	Item
Perceptions of importance of water for the environment	It is important to protect and manage the remaining wetlands in the region
	Provision for water for the environment is as important as provision of water for agriculture, towns and industry
	The quality and quantity of groundwater available to me is sufficient for all my needs

Details of the psychometric properties of the various indices and indicators can be found in Appendix 3. Overall the indices and indicators showed strong psychometric properties and were appropriate for use in this analysis. Further research will consider how to enhance the parsimony of this protocol as well as giving consideration as to how to integrate these indices and indicators with the economic environmental and demographic research being conducted in conjunction with this project.

Respondents were able to identify up to eight significant life stressors which could have occurred in the past year. The cumulative index of stressors (0-8) was summed by these responses and subsequently recoded into one of four groups, no life stressors, 1 or 2 life stressors respectively, and 3 or more life stressors. The Deakin Wellbeing Index was reported in two ways. Generally it is reported using its existing scale of 1- 10 where a score of one represents being completely dissatisfied with life and ten equates with being completely satisfied with life.

Approaches to understanding diversity within local communities

Just as every rural community is different, so too one can expect to find distinct differences within rural communities. A core aim of this study was to develop insights into the potential relationship between adaptive capacity and wellbeing, taking into account the kinds and combinations of stressors which are unique to each community. One way to conduct such a study is through the use of factor-cluster analysis. For the purposes of this study, the five key social indicators and one index of interest were used as the basis for the segmental analysis:

- individual adaptive capacity
- ability to work together
- community connectivity
- social support
- community leadership
- subjective wellbeing.

The key question of interest in this study was the risk of people within communities, or the community itself, facing a critical tipping point in human subjective wellbeing, taking into account the dynamics of community leadership and individual adaptive capacity. Because of the design of this study (being cross-sectional in nature), we were not able to draw conclusions as to whether or not people had in fact passed through a threshold in wellbeing. We could however, use cluster analysis to provide a profile of residents who attributes are those one might associate with those who are either at risk of, or who may have passed through such a threshold. After examining cluster solutions proposing 2, 3, and 4 groupings of the variables of interest, it was found that a 4 cluster solution uniquely presented distinct groupings between, including a group whose indicators were such as to suggest that a threshold may have been passed. Full details of the factor cluster analysis can be found in Appendix 2.

The choice experiment

Population decline is evident in many rural communities. What is less well known are the factors which underpin peoples' decision to stay in or leave their community. Choice experiments can assist us in understanding the key factors which underpin peoples' decision-making. Many actions in life involve people choosing between one action and another. People choose among competing options for things to do, for products to consume or even which social behaviours to exhibit that help explain who they are. People also choose to stay or leave communities that are impacted by major shocks – be they economic, social, disaster, environmental or demographic. People can also choose to act now, later, or not at all. But how can we determine what people will do in various situations as communities change?

While it is probably impossible to draw inferences about what one person would do it is possible to make predictions from the pattern of choices that groups of people might make.

By observing many peoples' trade-offs, you can infer the chances of a person deciding to stay or go as a community changes based on those aspects of a community that holds its members there and the socio-demographic characteristics of the person. To find the tipping point that causes people to leave a community, if executed as a traditional survey, such a survey would tell us that people would prefer their community with all the benefits but not when they would give up on that community. It is hard for people to disentangle what motivates them to choose one thing over another (i.e. it is often hard to describe what drives choice). A choice experiment requires that individuals be forced to make a trade-off between two or more options, sometimes also allowing 'None or Neither' as a valid response. This presentation of alternatives requires that some respondents decide whether their community with fewer benefits would still hold them. This information provides the key missing information necessary to understand the tipping points and if certain aspects of community are more important in keeping various segments in that community.

Figure 81 provides an overview of the possible trade-offs members of the communities were asked to consider with regards their decision to stay in their community.

Attributes	Level 1	Level 2	Level 3
1. Full time work	Levels of full time work are increased	Levels of full time work remains about the same	Levels of full time work are reduced
2. Part time work	Levels of part time work are increased	Levels of part time work remains about the same	Levels of part time work are reduced
3. Young people leaving	The proportion of young people and families remains the same	There is an increase in the number of young people leaving the community	Most young people leave the community and do not return.
4. The numbers of women (young and old)	The numbers of younger and older women remains the same	The numbers of younger women declines while the numbers of older women remains the same	There are fewer younger and older women in the community
5. Family and friends	Most family and friends remain in the community	Some family and friends have moved away	Most family and friends have moved away
6. Population change	Population remains as about the same (newcomers replace those who leave)	Population declines as few new people come	
7. Community and social life	Local sporting teams and local community groups continue as they are today	The local sporting teams can no longer continue	Local community groups can no longer continue
8. Education services	The local schools remain as they are	The high school closes and children have to be travel	The primary school closes and children have to travel
9. Health services	The current level of health services and doctors and /or nurses in the community remains the same	The local hospital closes	There is no local GP or community health service
10. Aged care	There is an increase in aged care services and facilities	The level of aged care services is maintained	There is a decline in the aged care services and facilities
11. Local businesses and employment	Some businesses and shops close but new and/or different businesses open	Some businesses, hotels (pubs) and the post office close but everything else is maintained	There are large numbers of closed shops and businesses
12. Tourism	Tourism increases	Tourism remains about the same	Tourism declines
13. Local Environment	The natural environment is improving	The natural environment is being maintained	The natural environment is being degraded

Figure 81 Factors used in the choice experiment

The results of the choice experiment provide the community and decision makers with an easy way to examine:

- how a change in the level of any given factor or combination of factors will affect people staying or leaving and their sense of wellbeing and what they may do differently
- acceptance or otherwise of scenarios, the impact on well-being and the tipping points for community sustainability – i.e. what will happen to the community
- the optimal settings to avoid a non-viable community (in social terms).

We note that the indicators reported in Figure 82 are preliminary only and were developed as part of the concept testing phase of this study. These indicators were developed primarily by the study group and not deeply in conjunction with stakeholders form the communities concerned. To be truly salient, and in keeping with the adaptive that *if you've seen one country town, you've seen just one country town*, these indicators need to be developed as part of a broader, community-based consultative process; a process which is informed by the preliminary economic and demographic work which occurred concurrently rather than prior to the existing project.

Vulnerability, adaptive capacity and wellbeing

Introduction

The one constant facing agri-dependent communities in Australia's Murray-Darling Basin is the ongoing social impacts of change. Change has resulted from a variety of factors including the longer term impacts of market liberalisation (Hogan and Young 2012), disruption to the structure of rural life (either as a result of rural decline or social displacement as a result of resource booms), climate change (Berry et al. 2011) including drought (Kenny Report 2008), periodic fire storms and flooding (Pittock et al. 2006), degradation of the river systems, changing rights to irrigated water (Murray-Darling Basin Authority 2012), solostalgia (Albrecht et al. 2007), loss of biodiversity (Namoi Catchment Management Authority 2007) and localised policy developments (Crean 2012). Such changes impact on people and their wellbeing in several ways. Without doubt the floods and fires of recent years took lives (ABC News 2009, Zwartz 2009), and destroyed homes and property (O'Gorman 2012, Tippet et al 2010). Similarly drought has been associated with an increased rate of farmer suicide (Hanigan et al. 2012). Most people fortunately survived such events. But in surviving such events they in turn have had to face other consequences of living in a changing environment. These changes have included economic loss with the flow through consequences of loss of livelihood, social disconnection and psychological distress (Kenny Report 2008). Given such impacts, there is increasing concern about the ability of people to cope with the short term impacts of localised stressors as well as being able to adapt to being exposed to longer term stressors (Berman et al. 2012). An important distinction is noted between coping and adapting (Berman et al. 2012).

The ecological literature makes it evident that physical environments are susceptible to collapse in the face of significant and/or persistent stressors (Gosling in press). However, these concepts have been less clearly developed and researched from the human perspective. Cummins (2009) has examined the sustainability of human wellbeing in the face of persistent environmental stressors. He has argued that individuals can sustain their sense of subjective wellbeing (SWB) overtime in the face of specific stressors up to a given point. In the face of shorter term and even significant life stressors he argued that people can bounce back or be resilient. However, he and his colleagues also argued that a threshold point exists with regards the intensity, and potentially, duration of persistent stressors, such that when this point is passed, individual wellbeing breaks down. The model is depicted in Figure 82.

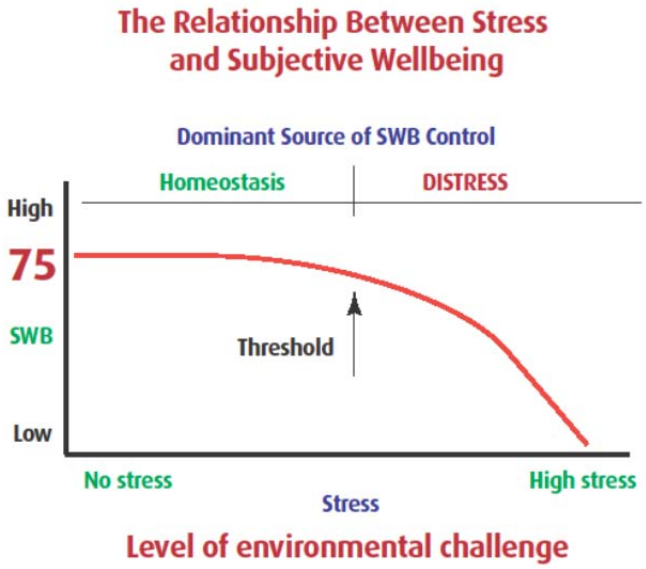


Figure 82 The theorised relationship between stress and subjective wellbeing

Source: Cummins 2010

The potential for a relationship to exist between environmental vulnerabilities and human wellbeing is implicit in the various studies on adaptive capacity (Blaikie et al. 1994; Nelson et al. 2007; Adger & Vincent 2005). However, the nature and extent of this relationship has not been well developed in the literature, particularly within rural settings and is recognised as a knowledge gap (Brondizio et al. 2009; Engle 2011; Fazey et al. 2010; Berman et al 2012).

Engle (2011, p. 49) suggests that 'the greater the adaptive capacity, the greater resilience and the greater ability there is for transformation' in the face of change. This is a common perspective offered within this emerging literature and it is a central theme promoted by policy makers (Crean 2012). Fazey et al. (2010, p. 375), for example, assert that 'adaptive capacity is increasingly recognized as essential for maintaining the resilience of social–ecological systems and for coping with environmental change' and that the 'human capacity to address human-induced and biophysical drivers of undesired ecological change' (Fazey et al 2010, p. 414) need to be fostered. Berry et al. (2011) reported an association between adaptive capacity and human health among Australian farmers facing the need to adapt to climate change. Drawing on the work of The Intergovernmental Panel on Climate Change, Berry et al. (2011) defined adaptive capacity as encompassing income, education, flexibility, innovation, social capital and health as well as the capacity to utilise technological options to solve problems. The study found that social capital and the intention to adapt were associated with wellbeing, as was the farmer's self-assessed health status.

An additional uncertainty in the literature is the extent to which, if at all, human beings like other species, face tipping points in wellbeing. Using Cummin's model, Tanton et al. (2012) found that in the face of specific vulnerabilities e.g. recent divorce, that a tipping point in wellbeing does exists. The idea of thresholds in wellbeing is central to another tension which exists within the literature concerning resilience and the capacity to transform in the face of change. Depending on how resilience is conceptualised (e.g. capacity to bounce back (e.g. Engle 2011)), such an adaptive capacity in some circumstances could be argued to be maladaptive; people fail to change when they need to and in turn, are at risk for longer term poorer health and social outcomes. Berman et al. (2012) identified the fact that people can put up buffers so that they can sustain existing practice in the face of a changing

environment. However, at issue is whether in fact there is a need to be able to transform, rather than to persist. While this may be a fine distinction it is an important one because the capacity to persist may in certain circumstances result in longer term maladaptation (Thomsen et al. 2012) which does not contribute to overall wellbeing. This was an outcome observed by Berry et al. (2011) and Hogan et al. (2011) in their studies of Australian farmers, many of who demonstrated adaptive capacity, but only in terms of making seasonal rather than longer term adaptations in the face of climate change. Central to this challenge then are three issues:

1. the capacity for individuals and their communities to be able to solve the problems they face, when under stress, such that they are able to maintain their current wellbeing

2. the longer term sustainability of such outcomes in relation to longer term socio-economic impacts and wellbeing

3. the extent to which human beings, in the face of persistent stressors, confront thresholds in wellbeing as suggested by Cummin's model.

This report takes up the first of these questions using data from a cross-sectional study. Working with communities which are subject to the kinds of vulnerabilities noted in the introduction to this paper, this study investigated whether an association could be observed in the data between adaptive capacity and wellbeing where adaptive capacity was operationalised as the capacity of individuals and communities to solve problems under stress. If such associations existed, longitudinal studies examining the potential for a causal relationship between environmental vulnerabilities and subjective wellbeing would be warranted since such insights could be used to enable communities to move beyond attempts to cope, and towards a focus on adapting to sustainable, longer term forms of settlement.

Results

Table 37 compares mean scores of the indicators used in this study by the participating communities. The results show that members of these communities perceive themselves as having high levels of individual and collective adaptive capacity and social capital, reporting approximate mean scores of 4 on a scale of 5. Wellbeing scores (which showed an average of 7.79 out of a possible 10), were slightly higher than Australia wide levels of 7.5. Statistically significant differences were evident between communities with regards the level of community connectivity, social support, stress and wellbeing.

Table 37 Benchmarking outcomes by communities

Indicator	Namoi	St George	Waikerie
Individual adaptive capacity	4.12	4.13	4.07
Ability to work together†	3.74	3.81	3.82
Community connectivity***	3.38	3.59	3.70
Social support***	3.85	3.74	3.62
Community leadership	3.17	3.22	3.25
Cumulative stress index***	.61	1.14	.52
Subjective wellbeing scale **	7.74	7.92	7.72

*Statistically significant differences were found between communities *** p<.001; ** p<.01. † Approached significance

Table 38 identifies the proportion of community members who reported scores in the negative range of the indicators (i.e. a scores below 3 on a scale of 5, a score below 6 on a scale of 10 on the Subjective Wellbeing Index and 3 or more recent stressors on the Cumulative Stress Index). It can be seen that overall, only a very small proportion of community members reported low perceived levels of adaptive capacity.

Table 38 Proportion of community members reporting negative scores on key indicators

Indicator	% reporting a negative score on the indicator
Individual adaptive capacity	1.3
Ability to work together	4.1
Community connectivity	10.7
Social support	7.7
Community leadership	25.1
Cumulative stress index	2.9
Subjective wellbeing scale	8.4

Slightly higher proportions of community members reported lower levels of community connectivity, (10.7%) or lacking confidence in their community leadership (25.1%); 8.4% reported lower levels of wellbeing.

Table 39 reports outcomes on the indices and indicators used in this study by key stakeholder groupings. Statistically significant differences were observed between groups with regards community connectivity, social support, community leadership and cumulative stressors.

Table 39 Benchmarking outcomes by stakeholder groups

	Primary producer	Town resident	Hobby farmer	Change agent
Individual adaptive capacity	4.08	4.12	4.12	4.15
Ability to work together	3.78	3.77	3.78	3.81
Community connectivity ***	3.63	3.46	3.57	3.58
Social support***	3.52	3.90	3.64	3.82
Community leadership***	3.04	3.29	3.12	3.10
Cumulative stress index***	0.89	0.66	0.79	0.79
Deakin wellbeing scale	7.86	7.78	7.79	7.79

***Statistically significant differences were found between communities $p<.001$.

As might be expected, change agents showed the highest level of individual adaptive capacity as well as reporting a higher level of ability to work with others. Primary producers reported the highest perception of being connected with others while town residents reported the highest perceptions of social support. The distinction between connectivity and support is noted. Town residents were also the greatest supporters of local decision-makers. On average, primary producers reported both the highest number of cumulative stressors and the highest subjective wellbeing score. However, mean differences on wellbeing were not statistically significantly different between participant groups.

Table 40 compares outcomes for community connectivity by stakeholder grouping. Over 90% of respondents reported enjoying community connectivity. Notably primary producers (Standardised Residual (SR) 3.0) were more likely to report greater connectivity than other stakeholders while town residents were more likely to report lesser connectivity (SR 3.0) (X2 (12) =26.2; p<.01).

Table 40 Community connectivity by stakeholder grouping (%)

Crosstab

% within Respondent Type

		Respondent Type				
		Primary Producer	Town Resident	Hobby Farmer	Change Agent	Total
Scale of community connectivity	low	0.4%	1.1%	0.8%		0.8%
	2.00	8.2%	11.8%	7.8%	7.3%	9.9%
	3.00	29.1%	35.9%	34.6%	35.4%	34.2%
	4.00	51.8%	42.5%	46.5%	49.0%	45.8%
	high	10.5%	8.7%	10.3%	8.3%	9.3%
Total		100.0%	100.0%	100.0%	100.0%	100.0%

Table 41 compares outcomes for stakeholders by their ratings of social support. Once again, over 90% of respondents reported enjoying social support. Notably town residents were more likely (SR 4.8) to report the highest perceptions of social support while primary producers reported the least (SR - 4.3) (X2 (12) =113.1; p<.001).

Table 41 Social support by stakeholder groupings (%)

Crosstab

% within Respondent Type

		Respondent Type				
		Primary Producer	Town Resident	Hobby Farmer	Change Agent	Total
Scale of social support	low	1.7%	1.3%	1.8%	0.5%	1.4%
	2.00	8.8%	5.8%	5.7%	4.7%	6.3%
	3.00	40.0%	20.2%	38.8%	27.1%	28.4%
	4.00	34.6%	46.5%	33.9%	47.4%	41.8%
	high	14.9%	26.2%	19.9%	20.3%	22.1%
Total		100.0%	100.0%	100.0%	100.0%	100.0%

Table 42 compares outcomes for stakeholder perceptions of the quality of their community leadership. Over three quarters of stakeholders provided positive ratings of their community leadership. Town residents (SR 2.0) were more likely to rate community leadership highly while primary producers were less likely to highly rate community leadership (-2.5) (X2 (12) =34.6; p<.001).

Table 42 Community leadership by stakeholder grouping

Crosstab

% within Respondent Type

		Respondent Type				
		Primary Producer	Town Resident	Hobby Farmer	Change Agent	Total
Community leadership scale	low	5.7%	5.2%	7.2%	9.4%	6.0%
	2.00	23.9%	16.7%	20.4%	18.8%	19.1%
	3.00	37.9%	32.9%	33.3%	34.4%	34.2%
	4.00	26.2%	34.8%	30.2%	27.1%	31.5%
	high	6.3%	10.4%	8.8%	10.4%	9.2%
Total		100.0%	100.0%	100.0%	100.0%	100.0%

Table 43 compares stakeholders on the cumulative index of significant life stressors. Notably, almost half (43.5%) the stakeholders reported no significant stressors in the past twelve months. Primary producers (SR 2.6) were more likely to report having experienced three or more significant stressors in the past twelve months while town residents were less likely to report such stressors (SR -2.5) ($X2$ (9) =37.8; $p<.001$).

Table 43 Cumulative life stressors by stakeholder grouping

Crosstab

% within Respondent Type

		Respondent Type				
		Primary Producer	Town Resident	Hobby Farmer	Change Agent	Total
Indicator - cumulative life stressors	None	36.3%	48.3%	38.8%	42.2%	43.5%
	1	43.6%	39.0%	47.3%	39.1%	41.5%
	2	15.5%	10.6%	10.6%	16.1%	12.2%
	3 or more	4.6%	2.0%	3.4%	2.6%	2.9%
Total		100.0%	100.0%	100.0%	100.0%	100.0%

Examining the relationship between adaptive capacity and subjective wellbeing

Table 44 examines correlations between the respective variables concerned with adaptive capacity, social capital and subjective wellbeing. Notable correlations include subjective wellbeing with individual adaptive capacity (.331), collective adaptive capacity (ability to work together) (.318) and community connectivity (.335). The variables of individual adaptive capacity and collective adaptive capacity were correlated (.193) and collective adaptive capacity and social support were correlated (.208). Collective adaptive capacity and community leadership were demonstrated the highest correlation in this study (.368).

Table 44 Correlations between items measuring adaptive capacity and wellbeing

	Individual adaptive capacity	Ability to work	Community connectivity	Social support	Community leadership	Cumulative stressors	Deakin wellbeing scale
Individual adaptive capacity	1	.193	.190	.069	.098	.003†	.331
Ability to work	.193	1	.334	.208	.368	-.031†	.318
Community connectivity	.190	.334	1	.132	.156	-.032†	.335
Social support	.069	.208	.132	1	.223	-.062	.180
Community leadership	.098	.368	.156	.223	1	-.063	.213
Cumulative stressors	.003†	-0.31†	-.032†	-.062	.063	1	-.055
Deakin wellbeing scale	.331	.318	.335	.180	.213	-.055	1

N=2,196; all correlations statistically significant at .05 (2 tailed) except for correlations for some cumulative stressors as denoted †.

Hierarchical linear regression was conducted to examine with the extent to which the various indicators of adaptive capacity were associated with subjective wellbeing. The statistical results of this analysis can be seen in Table 45 below.

Table 45 Associations between adaptive capacity and human wellbeing (including self-reported health)

Model	*B*	Standard error	Standardised beta coefficients	t	Sig.
Constant	1.162	.224		5.189	.000
Age group	.131	.018	.131	7.327	.000
Gender	.130	.046	.050	2.844	.004
Household income	.054	.010	.101	5.656	.000
Self reported health	.432	.023	.347	19.107	.000
Individual adaptive capacity	.378	.035	.198	10.93	.000
Community connectivity	.261	.029	.167	8.871	.000
Social support	.127	.026	.089	4.977	.000
Ability to work together	.225	.036	.123	6.184	.000
Community leadership	.097	.024	.077	4.093	.000

The model, which was statistically significant at each step in the analysis, accounted for 37% (F (9, 2099 = 139.3; p< .001) of the variance. Statistics concerning multi-collinearity were well within acceptable limits. Considering the variables of interest, self-assessed health was most highly associated (accounting for 27% of variance) with subjective wellbeing followed individual adaptive capacity (15%), community connectivity (13%), collective adaptive capacity (the ability to work together) (10%) and age (10%).

Discussion

This chapter reports on a preliminary investigation of whether an association was present between social indicators of adaptive capacity and subjective wellbeing amongst key stakeholders living in three rural communities which have encountered considerable environmental stressors over the last decade. This study drew on cross-sectional data to examine the research questions of interest. The findings of this study must be interpreted within the constraints of the study design; specifically that where results were observed, it is only possible to conclude that an association exists between the variables and that further research is indicated.

The study found, that on the basis of the indicators used, a majority of the members of the study communities reported high levels of self-assessed adaptive capacity and wellbeing. Among the respective stakeholder groups within the study communities, town residents reported enjoying higher levels of social support, less stress and greater support for their community leaders. Notably though they reported a lower level of perceived community connectivity. By contrast, primary producers, although reporting higher levels of perceived community connectivity, reported lower levels of social support, lower support for community leaders and higher levels of stress.

The study found that indicators of individual (.331) and collective (.318) adaptive capacity were correlated with measures of subjective wellbeing. This association was reaffirmed within a regression analysis which found that when taking into account the known relationship between self-assessed health and wellbeing (Berry et al. 2011), individual and collective adaptive capacity and community connectivity were was most highly associated with subjective wellbeing. The analysis accounted for 26% of the variation in subjective wellbeing. These data suggest a thesis that when communities are able to work well together, individuals enjoy higher levels of wellbeing.

A small group of residents consistently reported low perceived levels of adaptive capacity and subjective well-being. This relationship warrants further investigation and is considered in part in the section on ‘Recognising diversity within the adaptive capacity of rural communities’. The noted correlations between adaptive capacity and wellbeing lend support to Cummin’s thesis in the face of persistent stressors, some people may confront thresholds in wellbeing. This outcome also warrants further investigations within a longitudinal research study. Without longitudinal data one cannot know when or how changes in the factors associated with any change in wellbeing occurred or that they are the only factors contributing, if at all, to any identified outcome. Understanding and being able to monitor this relationship is important in enabling communities to be able to sustain their wellbeing overtime.

Perceptions of natural resource condition and human wellbeing

Introduction

It is a given that ecological systems provide a life support system for humans (Kellert 1996; Chaplin et al. 2009). However, the development of advanced human social systems is resulting in environmental degradation (Corvalan et al. 2005), to the extent that basic systems, which are deemed to be essential to providing life support for humans, are approaching potential thresholds points and are at risk of breaking down (Rockstrom et al. 2006). A similar model has been put forward for how environmental and social stressors impact on humans (Cummins 2009).

Beyond addressing concerns about the impact of human action on the thresholds which sustain ecological and human wellbeing, there is a more subtle approach in the literature which is concerned with a relationship between the state of the natural resource and human wellbeing. There are two aspects to this approach, one which holds that the quality of the natural environment contributes to human wellbeing while a second, argues that increasing harm to the environment is also resulting in harm to humans. Inherent in these notions of the environment are specific constructions of nature, endowed as it may be, with amenity values.

The literature has approached these perspectives through several lenses. The most notable of these is the biophilia thesis which asserts that 'human identity and personal fulfilment somehow depend on our relationship to nature' (Kellert 1993, p. 43). This thesis purports that humans being innately attracted to other forms of life and that this is good for people, enabling them to restore themselves from the stressors of modern life (Frumkin 2001, Parsons 1991, Tidball 2012). In reviewing the literature Parsons (1991) identified a range of health benefits associated with exposure to nature including reductions in anxiety, benefits to the immune system, reduced levels of cortisol (stress hormone) in the blood, as well as adding a restorative benefit to those who have been ill. Similarly, Fuller et al. (2007) associated psychological benefits (reflection, distinct identity, continuity with the past, attachment) with increased species richness (based on a survey of local amenity planting, grasslands, scrub, woodland, water and impervious surfaces). Fuller et al. (2007) argue that human wellbeing responds positively to exposure to green space. Citing a range of studies Fuller (2007) notes that exposure to green space has been associated with improved social relations, reduced mental fatigue and provided opportunities for reflection.

Just as environments with a green amenity have been seen to promote wellbeing, drying environments have been associated with reduced wellbeing. Albrecht et al. (2007 p, s95) proposed the concept of solastalgia which they defined as 'the distress that is produced by environmental change impacting on people while they are directly connected to their home environment'. This notion of solastalgia was supported by several studies of drought affected farmers in Australia. The Kenny Report (2008, p. 25) reported on drought induced depression while the Hogan et al. (2008) reported that drought affected farmers we were likely to report reduced satisfaction with life when compared with people not exposure to living in drought.

However, the notion that an environment has to be green to be satisfying to live in does not necessarily follow. It would suggest that people living in arid areas or those covered in ice, could not, by definition, live a satisfying life. Parsons (1991, p. 5) adds an important component to this debate when he observes that 'human responses to environments are a means by which people discern habitable from inhabitable environments'. Noting Zajonc (1980) and Ulrich (1983), Parsons (1991) observes that humans assess environments with regards their survival value. For Parsons (1991), a key part of any relationship centres on human perceptions.

This paper in turn takes up this question and examines the question of to what extent might human wellbeing may be associated with a person's perception of the state of the natural resource condition.

Research results

Table 46 reports outcomes on environmental measures by community. Statistically significant differences were observed between groups on each of the variables.

Table 46 Environmental outcomes by communities

	Namoi	St George	Waikerie
Perceptions of natural resource condition **	3.71	4.11	3.45
Importance of water for environment *	4.21	4.19	4.06

** p<.001; * p<.004.

Compared to the other communities, the Namoi community rated the state of their natural resource more highly than did St George or Waikerie (F(2,2028) =38.5; p<.001) while the Waikerie community provided less importance on water for the environment (F(2,2027) =5.6; P<.004). Overall, 66.8% of respondents thought that the natural resource was in a positive condition while 83% supported the provision of water for the environment. Within the analysis the standardised residuals (SR) reported within a Chi-squared analysis did not identify any specific community as being over-represented among those that did not support water for the environment, although the SR for Waikerie approached a score of 2 (1.9), which would have indicated that they were over-represented on this variable.

Table 47 below reports outcomes on these measures by key stakeholder groupings. Statistically significant differences were observed between groups on all of the variables.

Table 47 Environmental outcomes by stakeholder groupings

	Primary producer	Town resident	Hobby farmer	Change agent
Perception of natural resource condition ***	4.04	3.59	3.89	3.71
Importance of water for the environment ***	4.04	4.24	4.16	4.23

*** p<.001

The observed mean differences on perceptions of natural resource condition by stakeholder groups were statistically significant (F (3, 2183) = 17.5; p<.001). Post-hoc analysis (Scheffe) revealed that compared to primary producers, town residents and change agents had a poorer perception of natural resource conditions. Overall, two thirds (66%) of respondents considered that the natural resource condition was in good condition. Of all respondents proportionately more town residents (SR of 2 or greater) were less likely to consider that the natural resource was in good condition.

The observed mean differences on the importance of water for the environment were statistically significant (F (3, 2182) = 5.6; p<.001). Post-hoc analysis (Scheffe) revealed that compared to town residents, primary producers and hobby farmers were less likely to agree that water for the environment was important. Overall, a large majority of respondents (83.3%) agreed that water was important for the environment; primary producers were underrepresented (SR -2.2) among those providing such support.

Resource condition and human subjective wellbeing

The table below examines correlations between the respective variables concerned with human wellbeing and biodiversity. The correlations, as would be expected, are present but not exceptionally large. This makes sense when one thinks about the extent to which humans are able to live in a variety

of places irrespective of the state of environment. Nonetheless, these data demonstrate an association between perceptions of natural resource condition and subjective wellbeing (.178), individual adaptive capacity (.137) collective adaptive capacity (ability to work together) (.151) community connectivity (.180), community leadership (.100) and stress (.062).

Table 48 Correlations between items perceptions of biodiversity and wellbeing

	Natural resource condition	Water for environment	Individual AC	Collective AC	Connectivity	Social support	Leaders	Stress index	Well being
Natural resource condition	1	.092	.137	.151	.180	.051	.100	.062	.178
Water for environment	.092	1	.115	.128	.028†	.074	.099	-.010†	.088
Individual AC	.137	.115	1	.193	.190	.069	.098	.003†	.323
Collective AC	.151	.128	.193	1	.334	.208	.368	-0.31†	.315
Connectivity	.180	.028†	.190	.334	1	.132	.156	-.032†	.324
Social support	.051	.074	.069	.208	.132	1	.223	-.062	.181
Leadership	.100	.099	.098	.368	.156	.187	1	-.063	.206
Stress index	.062	-.010†	.003†	-.031†	-.032†	-.062	-.063	1	-.051
Wellbeing	.178	.088	.323	.315	.324	.181	.206	-.051	1

All correlations statistically significant at .05 or less (2 tailed) except for those marked †

Given the correlations between these variables, we next considered the extent to which respondents' perceptions the state of the natural resource condition. The remaining social indicators were included in the analysis because they are also known to impact on subjective wellbeing (Berry et al. 2011). The statistical results of this analysis can be seen in Table 49 below.

Table 49 Association of perceptions of natural resource condition with perceptions of subjective wellbeing

Model	*B*	Standard error	Standardised beta coefficients	t	Sig.
Constant	1.062	.238		4.464	.000
Perceptions of resource condition	.084	.020	.077	4.287	.000
Self-reported health	.432	.023	.339	18.407	.000
Individual adaptive capacity	.362	.036	.184	10.055	.000
Collective adaptive capacity	.228	.038	.122	6.042	.000
Community connectivity	.235	.031	.147	7.665	.000
Social Support	.135	.026	.093	5.105	.000
Community leadership	.085	.024	.066	3.461	.001
Cumulative life stressors	-.012	.030	-.007	-.397	.691
Gender	.145	.047	.054	3.060	.002
Age group	.126	.019	.123	6.719	.000
Household income	.055	.010	.101	5.588	.000

The model was statistically significant and accounted for 37% (F (11, 2088 = 109.2; p< .001) of the variance. Statistics concerning multi-collinearity were well within acceptable limits. Respondents' perceptions of the state of natural resources accounted for approximately 6% of the variance explained in the analysis.

Recognising diversity within the adaptive capacity of rural communities

A key focus of this study was to examine the potential relationship between social indicators and wellbeing. In particular, the Namoi CMA was interested to know whether humans faced tipping points in wellbeing. Just as it is evident that many rural communities are prospering, it is also evident that not everyone within a given community is doing well. Communities are made up of sub-groups of people whose risks and therefore whose subjective wellbeing, will differ. In this chapter we delve further into this question by looking at the social indicators of participants with a view to identifying which members of the community are doing well and which members of the community may be at risk. Once again, since the data available for the analysis are cross-sectional in nature, we cannot draw conclusions as to the causation of such outcomes. We can however propose possible relationships between risk factors which may be examined in future studies. The statistical procedures used in this analysis are again available in Appendix 2.

For the purposes of this study, six key social indicators used throughout this study (see explanation in 'Research Methods' section) served as the basis for the segmental analysis:

- individual adaptive capacity
- ability to work together
- community connectivity
- social support

- community leadership
- subjective wellbeing

Table 50 below presents the Anova table for the cluster analysis. These tables are used for informative rather than statistical purposes. The F scores in this table identify the indicator which has the most influence on the resulting cluster solution. Here it can be seen that community leadership and subjective wellbeing, followed by the ability to work together, are the most influential variables in the cluster solution.

Table 50 Anova table for the cluster analysis

ANOVA

	Cluster		Error			
	Mean Square	df	Mean Square	df	F	Sig.
Individual adaptive capacity	193.990	3	.736	2192	263.619	.000
Ability to work together	293.673	3	.599	2192	489.909	.000
Community connectivity	194.571	3	.735	2192	264.695	.000
Social support	219.411	3	.701	2192	312.961	.000
Community leadership	265.525	3	.638	2192	416.204	.000
Deakin wellbeing index	294.910	3	.598	2192	493.365	.000

The F tests should be used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal.

Figure 83 provides a visual presentation of the 4 cluster solution using standardised scoring. Within this figure, a score of zero represents an average score. Scores greater than zero represents a result which is above average and a score less than zero represents a score which is below average. The first grouping in the cluster analysis (pictured on the left of Figure 83 below) has been labelled *leadership without support.* Examining the result for this grouping it can be seen that the group has a slightly above average score on the indicators *ability to work together* and *community leadership.* This group reports a below average score for the indicators social support, individual adaptive capacity, community connectivity and wellbeing. This group is the second largest segment accounting for 30% of respondents. As such this is a group which has leaders and people who can work together, they enjoy less social support than members of other groups in this study. Thematically then the main characteristics of this group have been summarised as having *leadership* but perhaps *without the extent of community supports* which might either enable change or sustain these people through times of stress and challenge.

The second segment, labelled *going it alone*, reports an above average score for the indicator for *individual adaptive capacity* and a very slightly above average score for *wellbeing*. However, its scores on the indicators for *community leadership* and the *ability to work together* (collective adaptive capacity) are below average as are their scores on the indicator *community connectivity*. This is the third largest segment accounting for 22% of the sample. Thematically one can envisage a group of capable individuals who lack faith in the leadership in their community while also lacking the capacity to work well with others or to stay connected with the broader community. Bringing these main characteristics together one can envision a group of capable people who are working towards their goals without the support of others.

The third grouping reports above average scores on every indicator in this study. The enjoy above average scores on *individual adaptive capacity*, *ability to work together*, *community connectivity*, *social support*, *community leadership* and *subjective wellbeing.* This segment is the largest in the study and accounts for 37% of the sample. Thematically this is a group which is enjoying the kind of

social support which is legendary in country Australia and which depicts the iconic values of the *best of country living*.

In stark contrast to the third group, is the final grouping which reports below average scores on every single indicator. They report the lowest levels of *wellbeing*, *individual adaptive capacity*, the (in)-*ability to work with others* and the lowest levels of *community connectivity*. They also report below average levels of *social support* and faith in *community leadership*. This segment is the smallest in the study and accounts for 11% of the sample. Thematically one can envision people who are isolated within the community, lacking wellbeing and social support. When considered within a framework which is concerned with the social determinants of wellbeing, this group constitutes *people at risk*.

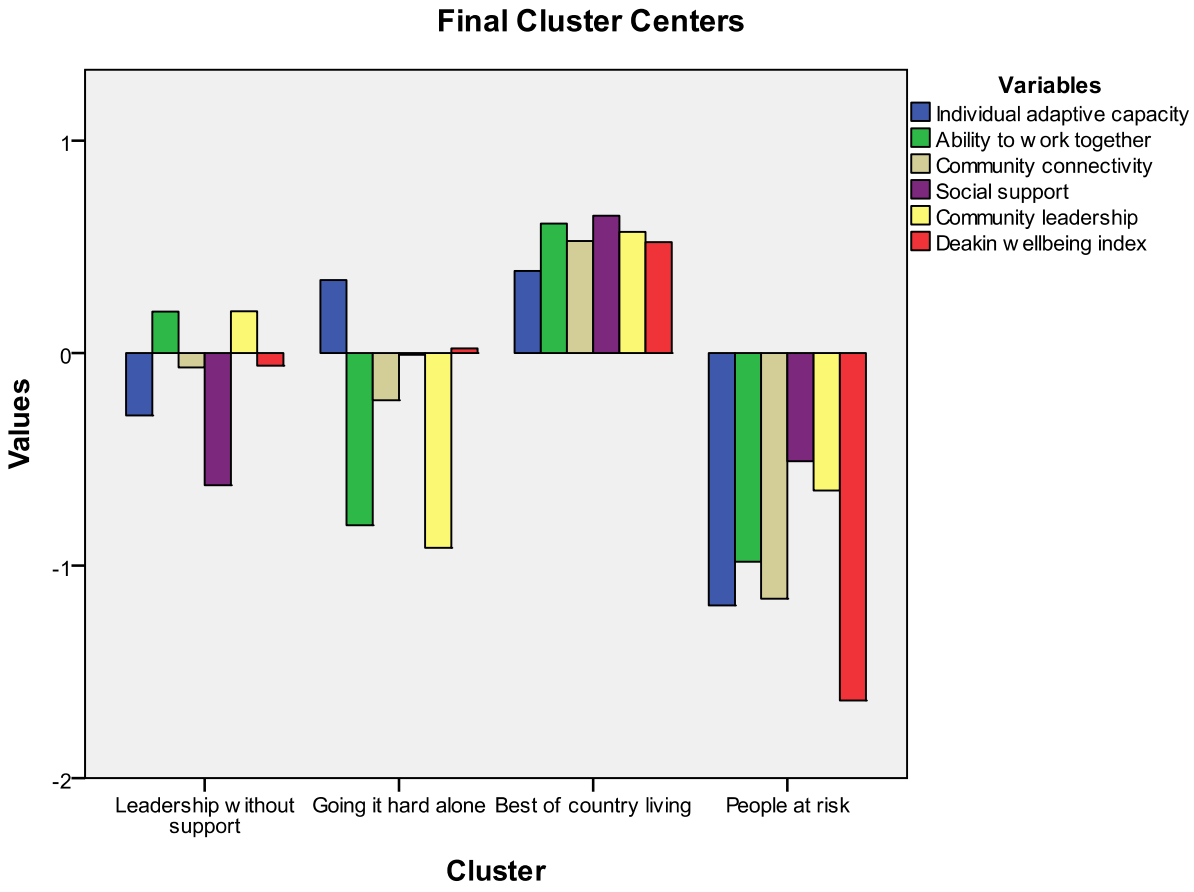


Figure 83 Visual presentation of the 4 cluster solution.

The results of this cluster analysis are presented in two parts. First, clusters are compared against each other across a series of measures reported in this study. Second, the distinct characteristics and descriptive factors associated with each cluster grouping are presented for each segment, providing for a typology of the adaptive capacity of rural communities facing the challenges of sustaining themselves amidst economic, environmental and social changes.

Based on the sampling within this study, across the segments one would expect to see 22% being primary producers, 18% hobby farmers, 52% town residents and 9% being change agents. In terms of locations, one would expect to see 46% in the Namoi, St George 30% and Waikerie 24%.

Comparing cluster segments

Table 51 provides data on participant type by cluster membership. Notably primary producers are over-represented within the segment of *leadership without support* (AR 3.6) while town residents were over-represented in the segment of *the best of country living* (AR 2.8) (χ^2 (6) = 23.7; p<.005).

Table 51 Participant type by cluster membership

	Leadership without support (%)	Going it hard alone (%)	Best of country living (%)	People at risk (%)	Total (%)
Primary Producer	26.7	20.7	18.7	20.7	21.7
Town resident	45.8	51.7	55.8	55.7	51.9
Hobby farmer	18.5	17.8	16.6	18.3	17.6
Change agent	9.1	9.8	8.9	5.3	8.7
Total	100	100	100	100	100

Table 52 below provides data on cluster membership by locality. Notably members of the Waikerie community are over-represented within the segment of *leadership without support* (Adjusted Residual (AR) 2.9) and under-represented in *going it hard alone* (AR -3.2). Members of the Namoi community were over-represented in the segment of *people at risk* (AR 2.5) (χ^2 (6) = 22.9; p<.002) and the Namoi approached significance for being over represented in the segment *going it hard alone* (AR 1.9).

Table 52 Locality by cluster membership

	Leadership without support (%)	Going it hard alone (%)	Best of country living (%)	People at risk (%)	Total (%)
Namoi	43	50	44	54	46
St George	29	32	32	23	30
Waikerie	28	18	24	23	24
Total	100	100	100	100	100

Table 53 provides data on time of residency by cluster membership. Compared to members of the segment *people at risk*, members of the segment *leadership without support* and members of the segment *best of country living*, had lived in their area for a shorter period of time (F (3, 2192) = 3.8; p<.009).

Table 53 Time of residence (average years) by cluster membership by locality

	Leadership without support	Going it hard alone	Best of country living	People at risk
Average years of residency	22.7	21.9	23.1	19.2

Table 54 provides data on cluster membership by age group. Younger residents (aged 18-44 years) were over-represented in the segment *best of town living* (AR 2.9) while older residents (aged 65-74 years) were over-represented in the segment *people at risk* (AR -2.0) (χ^2 (15) = 25.9; p<.04).

Table 54 Age groups by cluster membership

	Leadership without support (%)	Going it hard alone (%)	Best of country living (%)	People at risk (%)	Total (%)
18-24 years	0.3	1.7	2.8	2.1	1.8
25-34 years	5.4	5.8	6.7	6.2	6.1
35-44 years	14.4	16.1	13.4	14.9	14.5
45-54 years	21.0	20.3	19.7	27.4	21.1
55-64 years	27.6	29.3	27.5	26.1	27.8
65-74 years	32.2	26.8	29.9	23.2	28.8
Total	100	100	100	100	100

Table 55 provides data on cluster membership by gender. Notably male respondents were over-represented in the segment *going it hard alone* (AR 2.9) while female respondents were over-represented in segment *leadership without support* (AR 2.6) (χ^2 (3) = 11.6; p<.009).

Table 55 Gender by cluster membership

	Leadership without support (%)	Going it hard alone (%)	Best of country living (%)	People at risk (%)	Total (%)
Male	44.4	54.6	48.4	49.6	48.7
Female	55.6	45.4	51.6	50.4	51.3
Total	100	100	100	100	100

Table 56 provides data on cluster membership by educational outcome. The most notable differences between cluster members are reported by those who had a TAFE or equivalent qualification. These participants were over-represented in the segment *people at risk* (AR 2.6) and under-represented in the segment *best of country living* (AR -2.6) (χ^2 (21) = 46.4; p<.001).

Table 56 Educational outcomes by cluster membership

	Leadership without support (%)	Going it hard alone (%)	Best of country living (%)	People at risk (%)	Total (%)
Up to completing primary school	6.0	4.5	7.6	6.5	6.4
Some high school	34.4	32.4	40.5	39.8	36.8
Completed high school	17.4	19.0	17.7	13.8	17.5
TAFE/trade certificate	20.2	22.6	17.6	26.8	20.5
University course	20.8	20.9	16.3	13.0	18.3
Other	1.2	0.4	0.2		0.5
Total	100	100	100	100	100

Table 57 provides data on cluster membership by employment status. The most notable differences between cluster members is reported by members of the segment *people at risk* who were over-represented amongst those who report being unable to work (AR 9.2) and those who were unemployed

and looking for work (AR 4.0). Notably self-employed people were under-represented amongst the members of the *people at risk* segment (AR -3.0). A number of cell sizes in this analysis were low (less than five counts) and so it was appropriate to adjust the analysis using the Monte Carlo adjustment (linear-by-linear association) which is available within the SPSS statistical package; the result was statistically significant (χ^2 (21) = 12.4; p<.001). The most notable differences between cluster members is reported by members of the segment *people at risk* who were over-represented amongst those who were casually employed (AR 4.5) . Once again there were a number of cells with small cells sizes (less than 5 counts), notably amongst those on contract work. While the overall model was statistically significant, this significance was not retained once the adjustment was made for small cell sizes.

Table 57 Employment status by cluster membership

	Leadership without support (%)	Going it hard alone (%)	Best of country living (%)	People at risk (%)	Total (%)
Self employed	32.2	31.4	27.1	20.7	28.8
Employed for wages or in kind	30.2	37.4	33.3	31.3	33.1
Unemployed looking for work	1.1	0.8	1.0	4.1	1.3
Home duties	3.1	2.7	3.5	0.4	2.9
Full time student	0.5	-	0.1	-	0.2
Retired	28.8	23.8	31.1	26.0	28.3
Unable to work (not due to age)	3.2	2.9	2.9	15.9	4.5
Other	0.9	0.8	1.0	1.6	1.0
Total	100	100	100	100	100

Table 58 provides data on cluster membership by the nature of their employment, had they reported being in the workforce. The most notable differences between cluster members is reported by members of the segment *people at risk* who were over-represented amongst those who were casually employed (AR 4.5) . Once again there were a number of cells with small cells sizes (less than 5 counts), notably amongst those on contract work. While the overall model was statistically significant, this significance was not retained once the adjustment was made for small cell sizes.

Table 58 Nature of employment status for those reporting being in paid work by cluster membership

	Leadership without support (%)	Going it hard alone (%)	Best of country living (%)	People at risk (%)	Total (%)
Full time	68.1	70.8	70.2	58.6	68.7
Part time	23.5	19.5	20.7	19.5	21.1
Casual	5.7	8.2	7.8	18.8	8.3
Contract	2.7	1.5	1.2	3.1	1.9
Total	100	100	100	100	100

Table 59 provides selected descriptive data on cluster membership by industry of employment. There were no statistically significant differences within the basic model.

Table 59 Main industries employed within by cluster membership

	Leadership without support (%)	Going it hard alone (%)	Best of town living (%)	People at risk (%)
Agriculture etc	46	40	36	34
Health care; social assistance	10	14	12	13
Education and training	8	8	9	8
Retail trade	6	6	7	6
Transport, warehousing	5	3	3	8
Administrative and support services	4	6	6	4
Accommodation & food services	4	3	4	8

Table 60 provides data on job satisfaction by cluster membership. Members of the segment *people at risk* reported the lowest level of agreement for having job security (mean of 4.3 versus means of approximately 5.4 and higher for the other groups) ($F (3, 1355) = 30.4$; $p<.001$). Members of the segment *best of town living* reported the highest level of agreement of good job security with an average of 5.9 on a scale of 7. This pattern of results was consistent across the other variables within this part of the analysis. Members of the segment *people at risk* reported the lowest level of agreement for being satisfied with the amount of leisure time they enjoyed (mean of 3.9 versus means of 4.6 and higher for the other groups). Members of the segment *best of town living* reported the highest level of agreement of satisfaction with leisure time reporting an average of 5.3 on a scale of 7 ($F (3, 1355) = 19.5$; $p<.001$). Members of the segment *people at risk* reported that the highest mean score of agreement that work and family life also interfered with each other ($F (3, 1355) = 9.05$; $p<.001$) and that their work was too demanding and stressful ($F (3, 1355) =5.03$; $p<.002$), while members of the segment the *best of country living* reported the lowest mean scores for these variables.

Members of the segment *best of town living* were most optimistic about their ability to continue to earn a living in the town (area) of interest, reporting an average score of 3.9 on a scale of 5 ($F (3, 2192) = 43.6$; $p<.001$). Members of this segment were over-represented amongst respondents who were very positive about their capacity to earn an income in the town (AR 6.5) while members of the segment *people at risk* were notably over-represented (AR 5.5) amongst respondents who were very negative about their capacity to earn an income in the town, as were members of the segment *going it hard alone* (AR 3.0). Members of the segment *leadership without support* were under-represented amongst those who were very negative about their capacity to earn an income in the town (AR -3.1) and under-represented amongst those who were very positive (AR -4.7); they were however, over-represented amongst those who were just positive about their capacity to earn an income in the town (AR 3.1) ($\chi^2 (12) = 173.2$; $p<.001$).

Table 60 Job satisfaction by cluster membership

	Leadership without support (%)	Going it hard alone (%)	Best of country living (%)	People at risk (%)
I have good job security (agrees)	83	83	91	67
Satisfied with amount of leisure time (agrees)	49	55	49	37
Work and family life often interfere with each other (agrees)	59	55	49	67
My work is too demanding and stressful (agrees)	55	46	49	63
Ability to continue to earn an income in this town (positive)	55	57	65	33

Table 61 provides insight into the kinds of employment options participants believed were available to them should they lose their current form of employment. Given the large number of options, the number of cell with small counts (less than 5) was high and the model was therefore not significant when adjustments were made for small cell sizes. Nonetheless, some notable trends were evident in the data. Members of the segment *people at risk* considered it unlikely (AR -2.5) that they could find another job locally and that they would go on the dole (AR 4.8). Similarly members of the segment *going it hard alone* were more likely to leave town if they lost their jobs (AR 2.8). Members of the segment the *best of country living* were more likely to consider that they would find employment locally (AR 3.5) whole members of the segment the *leaders without support*, were also more likely to leave the area (AR -2.7).

Table 61 Employment options by cluster membership

	Leadership without support (%)	Going it hard alone (%)	Best of town living (%)	People at risk (%)	Total
Go on the dole	2.3	1.0	1.2	6.1	2.0
Retire	38.1	31.6	36.7	29.7	35.2
Leave town to get a job	9.1	11.9	6.3	9.8	8.7
Get another job locally	26.0	31.8	34.6	23.2	30.2
Rely on partner's job	4.6	4.8	4.6	5.7	4.8
Sell assets to enable you to live	2.8	2.1	1.5	2.8	2.1
Sell business (if business owner)	1.7	1.3	1.1	1.6	1.4
Change business (if business owner)	0.8	0.6	0.2	0.8	0.5
Start a new business	2.0	2.3	1.9	0.4	1.9
Other	12.6	12.6	11.8	19.9	13.1
Total	100	100	100	100	100

Table 62 provides data on respondents' self-assessed health by cluster membership. Members of the segment *people at risk* were more likely than other cluster groups (AR 10.5) to rate their health as poor, while members of the segment *the best of country living* were more likely to rate their health as either very good (AR 3.9) or excellent (AR 4.7). Members of the segment the *leaders without support*, were under-represented in the category of those who rated their health as excellent (AR -3.4) (χ^2 (12) = 220.9; p<.001).

Table 62 Self-reported health by cluster membership

	Leadership without support (%)	Going it hard alone (%)	Best of country living (%)	People at risk (%)	Total
Poor	4.9	3.3	1.8	18.7	5.0
Fair	15.4	15.5	10.8	29.7	15.3
Good	37.1	35.1	32.3	30.5	34.2
Very Good	32.8	30.3	37.1	16.7	32.1
Excellent	9.7	15.7	18.0	4.5	13.5
Total	100	100	100	100	100

Table 63 reports data on significant life stressors reported by cluster group members in the year prior to the survey. A cumulative life stress index was developed for this indicator, being a basic count of the number of life stressors experienced in that year. On average, members of the segment *people at risk* reported the highest average number of stressors of 0.88 stressors in the last year. This outcome was statistically significantly higher than members of other clusters. Post-hoc analysis identified that members of the segment *the best of country living* experienced statistically significantly fewer stressors in the past year, reporting an average of .0699 stressors per person (F (3,2192) = 3.18; p<.02).

Members of the segment *persons at risk* were more likely (AR 3.0) to report that someone close to them had died during the past 12 months.

Table 63 Life stressors experienced in last 12 months by cluster membership

	Leadership without support (%)	**Going it hard alone (%)**	**Best of town living (%)**	**People at risk (%)**
Experienced natural disaster	41	42	38	42
Were in fire or explosion	4	4	2	2
Transport accident	3	3	4	8
Had serious accident (not transport)	5	4	5	9
Experienced life-threatening illness or injury	9	9	7	19
Someone close to you died	32	31	31	41

Table 64 Index of average cumulative life-stressors experienced in the past year

	Leadership without support (%)	Going it hard alone (%)	Best of town living (%)	People at risk (%)
Mean stressors experienced	.76	.78	.699	.88

Table 65 reports data on the impact on respondent's financial and emotional wellbeing as a result of recent natural disasters, notably floods and droughts. Members of the segment l*eaders without support* reported an average score of 4.4 (on a scale of 7 of increasing agreement versus a group average of 4.2) for the statement that their financial wellbeing had been impacted by the droughts which occurred between 2000 and 2010. This difference was statistically significant. Post-hoc analysis showed that compared with those enjoying *the best of country living* (mean score of 4.0), the *leaders without support* rated themselves as being more financially impacted by the droughts ($F(3,2169) = 3.3$; $p<.02$). The financial effects of the flooding however were rated as more severe by the members of *people at risk* (mean score of 3.6 compared with a group average of 3.2), particularly when compared with members of *the best of country living* (mean score of 3.0) ($F(3,2160) = 4.3$; $p<.005$).

The emotional impacts of the droughts were most highly rated by those *leaders without support* (mean score of 4.3 versus a group average of 3.9); post-hoc analysis showed that members of *the best of country living* reported a statistically significantly lower mean score of 3.6 ($F(3,2171) = 10.1$; $p<.001$) than *leaders without support*. The emotional impacts of the flood followed a similar pattern to that of the drought. The emotional impacts of the floods were most highly rated by *people at risk* (mean score of 3.6 versus a group average of 3.2); post-hoc analysis showed that members of *the best of country living* reported a statistically significantly lower mean score of 3.97 compared to that of the at risk group and those *leaders without support* ($F(3,2157) = 5.95$; $p<.001$).

Table 65 Mean score environmental events impacted on the financially or emotionally by segments

	Leadership without support (%)	Going it hard alone (%)	Best of town living (%)	People at risk (%)	Overall mean	
Financial wellbeing impacted by drought e.g. 2000-2010	4.7	4.3	4.0	4.2	4.2	(F (3,2169) = 3.3; p<.02)
Financial wellbeing impacted by flooding e.g. 2011, 2012	3.3	3.3	3.0	3.6	3.2	(F (3,2160) = 4.3; p<.005)
Emotional wellbeing impacted by drought e.g. 2000-2010	4.3	3.9	3.6	4.0	3.9	(F (3,2171) = 10.1; p<.001)
Emotional wellbeing impacted by flooding e.g. 2011, 2012	3.3	3.2	2.9	3.6	3.2	(F (3,2157) = 5.6; p<.001)

Note. Scale 1 Strongly disagree – 7 strongly agree

Table 66 provides data on household structure by cluster segments. Members of the *people at risk* segment were over-represented in households of single people aged over 30 years (AR 3.9). Members of the *going it hard alone* segment were over-represented in share accommodation households (AR 2.7) and households with most children aged under 16 years of age (AR 2.1). Members of the *best of country living* segment were over-represented in households without children (AR 2.2) (χ^2 (18) = 45.7; p<.001). The model remained significant when statistical adjustments were made for small cell sizes.

Table 66 Household structure

	Leadership without support (%)	Going it hard alone (%)	Best of town living (%)	People at risk (%)	Total
Single; under 30 years	0.9	1.0	1.7	2.0	1.4
Single 30 years and over	16.6	13.6	15.7	25.2	16.6
Share accommodation	2.0	4.6	2.1	3.7	2.8
Couple without children	31.1	25.7	32.1	22.0	29.3
Family with most children under 16 yrs	16.5	19.9	19.1	20.3	18.6
Family with most children 16 yrs and over	32.5	35.1	29.3	26.8	31.2
Other	0.3	0.0	0.1	0.0	0.1
Total	100.0	100.0	100.0	100.0	100.0

Table 67 provides data on household income by cluster segments. Members of the *leadership without support* segment were under-represented in households where income was $120,000 or more (AR -2.1) while members of the segment *going it hard alone* were over represented in this segment (AR 2.8).

Members of the *people at risk* segment were over-represented in households where income was less than $10,000 (AR 3.8) and where income was $10,000 and less than $20,000 (AR 3.8). Members of the *going it hard alone* segment were over-represented in share accommodation households (AR 2.7) and households with most children aged under 16 years of age (AR 2.1). Members of the *best of country living* segment were over-represented in households without children (AR 2.2) (χ^2 (24) = 63.3; p<.001). The model remained significant when statistical adjustments were made for small cell sizes.

Table 67 Household income

	Leadership without support (%)	Going it hard alone (%)	Best of town living (%)	People at risk (%)	Total
Less than $10,000	1.8	1.3	2.4	5.7	2.4
$10,000 - less than $20,000	14.2	9.6	14.0	22.0	14.0
$20,000 - less than $40,000	18.3	20.1	17.6	22.4	18.9
$40,000 - less than $60,000	16.8	14.4	15.8	12.6	15.4
$60,000 - less than $80,000	12.3	13.2	11.7	10.2	12.0
$80,000 - less than $100,000	9.1	7.9	8.9	4.5	8.2
$100,000 - less than $120,000	4.9	6.5	5.1	4.5	5.3
$120,000 and over	7.2	12.6	10.4	4.1	9.2
Refused	15.3	14.4	14.1	14.2	14.5
Total	100.0	100.0	100.0	100.0	100.0

Table 68 provides data on community participation by cluster group membership. Some notable differences were observed between members of the respective segments. Members of the segment *going it hard alone* (AR -2.9) and *people at risk* (AR -2.5) were underrepresented among members of religious groupings while members of *leaders without support* (AR 2.0) and *the best of country living* (AR 2.1) were over represented (χ^2 (3) = 17.7; p<.001). Members of the segment *leaders without support* (AR 2.9) were over-represented in farm industry groupings (χ^2 (3) = 12.9; p<.005) while members of *people at risk* (AR -2.8) were underrepresented. In sporting clubs, members of the *best of country living* (AR 2.5) were over-represented while members of *people at risk* (AR -2.8) were underrepresented (AR -3.7).

Table 68 Community participation by cluster membership

	Leadership without support (%)	Going it hard alone (%)	Best of town living (%)	People at risk (%)	Total (%)
Service Clubs (n=304)	29	18	43	10	100
Religious/Church group (n=552)	33	17	41	8	100
Sports club (n=748)	28	23	41	8	100
Country Fire Assoc (n= 211)	31	25	35	10	100
Farm Industry Group (n=228)	38	21	36	6	100
Environmental group(n=144)	37	22	34	7	100
Community arts/drama (n=244)	32	17	39	11	100

A typology of the adaptive capacity of rural communities

Segment 1 – Leadership without support

This is the second largest segment accounting for 30% of respondents. Respondents in this segment reported slightly above average perceptions of the efficacy of community leadership and the ability to work together while reporting below average scores on all the other indicator particularly social supports. Primary producers (26.7% versus an expected 22%) were over-represented in this segment (AR 3.6) as were residents of the Waikerie (28% versus an expected 24%) (AR 2.9). Members of this segment have lived in their area for an average of 22.7 years and were more likely to be female (55.6%) (AR 2.6); just under two thirds of the segment (60%) were aged over 55 years of age. Some 41% of this segment had post-school qualifications and approximately two thirds (62%) of this segment had a paid job (or were self-employed) while just under one third (29%) were retired. Of those in work, 68% worked fulltime, most commonly in agriculture (46%) health or social services (10%), education and training (8%) and retail (6%). Just 3.2% reported not being able to work. A majority of this segment (83%) reported that they had good job security, with 55% of those working reporting being positive that they could continue to earn another income in their area if they lost their job; notably just 1.4% (AR – 3.1) were very negative about their ability to earn another income locally. If faced with losing their job, more than one third (38%) said they would retire while 26% said that they would get another job locally; 9% indicated that they would need to go to another town for work. More than half (59%) of the members of this segment reported positive work/life balance while 49% reported that they had sufficient leisure time. More than one third of the segment (41%) reported that they had experienced a natural disaster in the last 12 months while 32% reported that someone close to them had died in the last year. While the majority of this segment (80%) rated their health as good or better they were under-represented amongst respondents reporting their health as excellent (AR -3.4). Some 3% of this segment reported scores for subjective wellbeing below the threshold level. Members of this segment reported the second lowest mean cumulative stressors score of 0.76 significant life events in the past year. Just 16.5% of households identified as a family with children aged under 16 years of age. Members of this segment were under-represented in households where income was $120,000 or more (AR -2.1). They also reported that their financial wellbeing had been impacted by the droughts which occurred between 2000 and 2010 with the emotional impacts of the drought being most noticed by this group. Members of this segment were over-represented among church groups and farm industry groups. Attempts to build resilience within this part of the community might focus on

the challenge as to how the community gets in behind and provides support for what is predominately a group of women leaders who are trying to make a difference.

In summary, this is the second largest segment (30%). This segment reports above average perceptions of the efficacy of community leadership and the capacity to work together but below average perceptions of adaptive capacity, connectivity, individual adaptive capacity and wellbeing. Primary producers were well represented in this segment as were women and people living in Waikerie. Approximately two-thirds of this segment was in some form of full time paid employment. They enjoyed good job security and felt they had employment options should they lose their current job. Notably more than one third would retire if they lost their current job. Climate events, particularly droughts had financially as well as emotionally impacted on this segment. They report as being in good but not excellent health. They are highly involved in church and sporting groups.

Segment 2 – Going it hard alone

This is the third largest segment accounting for 22% of respondents. Respondents in this segment reported above average levels of individual adaptive capacity and slightly above average levels of wellbeing while reporting below average scores on all the other indicators particularly with regards the ability to work with others and their perceptions of the efficacy of their community leadership. No particular resident type was over or under-represented in this segment. Respondents' from the Waikerie community were under-represented in this segment (AR -3.2) while respondents' from the Namoi community approached statistical significance for being over represented in the segment (AR 1.9). Members of this segment have lived in their area for an average of 21.9 years. Members of this segment were more likely to be male (55%) (AR 2.9) and with just over half the segment (56%) being aged over 55 years of age. Some 45% of this segment had post-school qualifications and more than two thirds (68%) of this segment had a paid job (or were self-employed) while just under one quarter (24%) were retired. Of those in work, 71% worked fulltime, most commonly in agriculture (40%) health or social services (14%), education and training (8%) and retail (6%). Just 3% reported not being able to work. A majority of this segment (83%) reported that they had good job security, with 57% of those working reporting being positive that they could continue to earn another income in their area if they lost their job. A small but important proportion of this segment (5.2%) were over-represented (AR 3.0) among those who were very negative about their ability to earn another income locally, if they lost their current job. If faced with losing their job, approximately one third (32%) said they would retire while 32% said that they would get another job locally. Some members of this segment (12%) were more likely (AR 2.8) to need to go to another town for work if they lost their current position. More than half (55%) of the members of this segment reported that work and family life often interfered with each other , 46% reported that the demands of their job were too stressful and 45% reported that they did not have sufficient leisure time. More than one third of the segment (42%) reported that they had experienced a natural disaster in the last 12 months while 31% reported that someone close to them had died in the last year. The majority of this segment (81%) rated their health as good or better. Some 4% of this segment reported scores for subjective wellbeing below the threshold level. Members of this segment reported the lowest mean cumulative stressors score of 0.78 significant life events in the past year. An average 19.9% of households identified as a family with children aged under 16 years of age. Notably members of this segment were over-represented in share accommodation households (AR 2.7). Members of this segment were over represented (AR 2.8) in households where income was $120,000 or more and were under-represented among those community members who attended a church.

Summarising this third largest segment (22%), the group reports above average levels of individual adaptive capacity and slightly above average wellbeing while reporting below average scores on the other indicators. Respondents' from the Waikerie community were under-represented in this segment (AR -3.2) while respondents' from the Namoi community approached statistical significance for being over represented in the segment (AR 1.9). Members of this segment were more commonly men, to be aged over 55 years, although no one particular participant or industry type was more common than others. As with other segments, agriculture was the main employer. Members of this segment were

also more likely to be living in shared accommodation and a disproportionate number reported earning incomes in excess of $120,000 per annum. As with other groups, if they lost their jobs one third would retire but a large proportion (12%) considered that they would need to leave the area to find further employment. Members of this segment were less likely to be involved in church activities. Taken together these indicators paint a picture of capable individuals who lack community connectivity and support and who are vulnerable to change, particularly in agriculture.

Segment 3 – The best of country living

This is the largest segment representing 37% of respondents. Members of this segment report above average scores on all the social indicators examined in this study. They enjoy above average levels of adaptive capacity, the ability to work together, community connectivity and leadership, social support and subjective wellbeing. The members of this segment were slightly more likely to be town residents (56% versus an expected 52% of the segment). The St George community trended towards being over-represented in this segment (AR 1.6). Members of this segment have lived in their area the longest, with an average residency of 23.1 years. There are no significant differences in this segment by gender. Younger residents, aged 18-24 years were over-represented in this segment (AR 2.9) while 57% of this segment was aged 55 years and over. Just over one third of this segment (34%) had post-school qualifications and approximately two thirds (60%) of this segment had a paid job (or were self employed) while almost one third (31%) were retired. Members of this segment were under-represented among those with trade qualifications (AR -2.6). Of those in work, 70% worked fulltime, most commonly in agriculture (36%), health or social services (12%) or education and training (9%). Just 2.9% reported not being able to work. A majority of this segment (91%) reported that they had good job security. Moreover, some two thirds of this segment who were in the workforce (65%) reported being positive that they could continue to earn another income in their area if they lost their job. Members of this segment were strongly over-represented in being very positive about finding another job locally (AR 6.2). If faced with losing their job, more than one third (37%) said they would retire while 35% said that they would get another job locally. Just under half (49%) of the members of this segment reported that work and family life often interfered with each other, 49% reported that the demands of their job were too stressful while 49% reported that they had sufficient leisure time. Members of this segment reported the lowest mean cumulative stressors score of 0.699 significant events in the past year. Similarly this segment had the fewest (38%) reporting having experienced a natural disaster in the prior twelve months while 31% reported that someone close to them had died during this time. Members of this segment reported the best health with 87% rating their health as good or better. Only 1% of this segment reported scores for subjective wellbeing below the threshold level. Members of this segment reported being less financially or emotionally impacted by drought and flood events. Members of this segment were over-represented among those who rated their health as very good (AR 3.9) and excellent (AR 4.7). .Members of this segment reported the lowest mean cumulative stressors score of 0.699 significant life events in the past year. Members of this segment were over-represented as couples with no children (AR 2.2). While members of this segment reported a higher proportion of respondents' households where income was $120,000 or more (10.4% versus 9.2%), this difference was not statistically significant. Members of this segment were over-represented among those community members who attended a church (AR 2.1) and those involved in sporting clubs (AR 2.5).

In summary, the *best of country living* is the largest segment (37%) with members enjoying above average adaptive capacity, connectivity, social support, ability to work together, community leadership and wellbeing. They are more likely to be town residents. While no single community stood out, the St George area trended towards being predominant in this segment. There were no significant differences in this segment by gender. However, this segment did enjoy an over-representation of younger people. Two thirds of this segment is in some form of full time paid employment; they reported the highest levels of job security, and were commonly working in agriculture, health services or education. Unlike other segments, these respondents were very positive about their capacity to find another job n the area, if they needed to. The segment had an under-representation of trades people. Members of this segment reported being less financially or emotionally impacted by drought and flood events. They

report the lowest mean level of cumulative stressors (0.699). They reported the best health of all the segments and they also reported a higher proportion of people in the highest income level (although this difference was not statistically significant). They were more likely to live in households with no children and they reported above average levels of involvement in churches and sports clubs.

Segment 4 – Residents at risk

This is the smallest segment, comprising a small but notable 11% of respondents. They are however, the most at risk segment reporting below average perceptions on scores on all the social indicators examined in this study. They reported below average perceptions of their adaptive capacity, the ability to work together, community connectivity and leadership, social support and subjective wellbeing. Members of this segment were equally represented across both respondent types as well as the participating communities, save for the factor that they lived in their communities for an average residency of 19.1 years compared with the average of 22.3 years. There are no significant differences in this segment by gender or age; 49 % of this segment being aged 55 years and over. More than one third of this segment (40%) had post-school qualifications. Members of this segment were over-represented among those respondents' with a TAFE or equivalent qualification (AR 2.6). Just over half (52%) of this segment had a paid job (or were self-employed) while almost one quarter (26%) were retired. Members of this segment were over represented among those reporting being unable to work (16%; AR 9.2) as well as those unemployed and looking for work (4.1%; AR 4.0). They were notably less likely to be self-employed (AR -3.0). Of those in work, a below average 59% (compared with an average of 69%) worked fulltime. Members of this segment were over-represented among those employed casually (19% versus 8.3%; AR 4.5). Those employed worked most commonly in agriculture (34%), health or social services (13%), transport (8%), accommodation services (8%) or education and training (8%). Members of this segment reported the lowest levels of job security (average of 4.3 versus 5.4) with 67% agreeing that they had good job security. They were similarly the less satisfied with the amount of leisure time they enjoyed (AR 3.8) and were more likely to report that work and family life interfered with each other (AR 3.6). Just one third this segment who was in the workforce (33%) reported being positive that they could continue to earn another income in their area if they lost their job, being under-represented among those expecting to be able to find another job locally (AR -2.5). If faced with losing their job, a quarter (23%) said that they would get another job locally while less than one third (29%) said they would retire. Members of this segment reported the highest mean cumulative stressors score of 0.88 significant events in the past year. Within this segment 42% reported having experienced a natural disaster in the prior twelve months; 41% reported that someone close to them had died during this time, the highest of any segment (AR 3.0). Members of this segment reported the worst health with just 52% rating their health as good or better. This segment had the highest proportion (56%) of respondents who reported subjective wellbeing at below threshold levels. Members of this segment were over-represented among those who rated their health as poor (AR 10.5). Members of this segment were over-represented in households of people single and over 30 years of age (AR 3.9) while 20% of households identified as a family with children aged under 16 years of age. Members of this segment reported the lowest incomes with respondents being over-represented in households where income was less than $10,000 (AR 3.6) and between $10,000 and less than $20,000) (AR 3.8). Members of this segment were under-represented among those community members who attended a church (AR -2.5) and those involved in sporting clubs (AR -2.8).

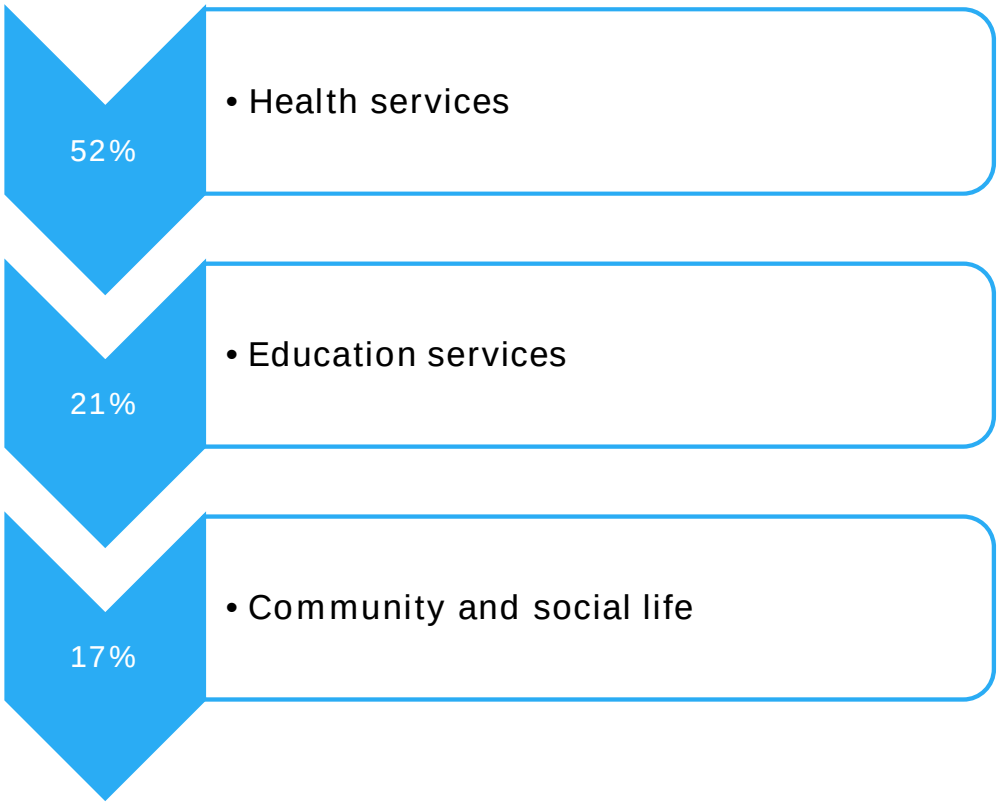
In summary, this is the smallest segment, comprising a small but notable 11% of respondents. They are however, the most at risk segment reporting below average scores on all the social indicators examined in this study. They report experiencing below average perceptions of their adaptive capacity, the ability to work together, community connectivity and leadership, social support and subjective wellbeing. Members of this segment were equally represented across both respondent types as well as the participating communities, save for the factor that they lived in their communities for an average residency of 19.1 years compared with the average of 22.3 years. Members of this segment were the most vulnerable in the workforce. They reported the lowest rate of full-time employment and were notably over-represented amongst the casual workforce. They were also over-represented amongst those with TAFE and equivalent qualifications. As well, they were more likely to be physically unable

to work or to be unemployed. Those in work reported the lowest levels of job security and were more likely to report that work and family life interfered with each other and that they were dissatisfied with the amount of leisure time they had. If they lost their job they expected that it would be more difficult than others to find another job locally. They reported the highest cumulative life stressors and the worst health. They were more likely to be in households of single people aged over 30 years and were over-represented within the two lowest income groupings. They were less socially connected being more likely to not be involved in either church or sporting groups.

How rural communities may be affected by changes in the availability of services.

Rural decline has been, and remains, a key issue facing the viability of many rural communities. In this chapter we report on the results of a study where we examined a range of social factors which may underpin a person's decision to remain living in a given rural community. The methods which underpinned this study were described in the 'Research Methods' and Appendix 2.

As can be seen in the figure below, the key factors underpinning a person's decision to stay in a given community are health services, education services and community life. People working in the health and education sectors made up approximately 21% of the regional community. Notably, in the scenario of the local hospital closing, town residents (SR 23.4) were very likely to say they would definitely leave, followed by hobby farmers (SR 3.2). Primary producers (SR 52.0) and change agents (SR 44.2) were most likely not to leave the area (X^2 (12) = 6582.1; p<.001).



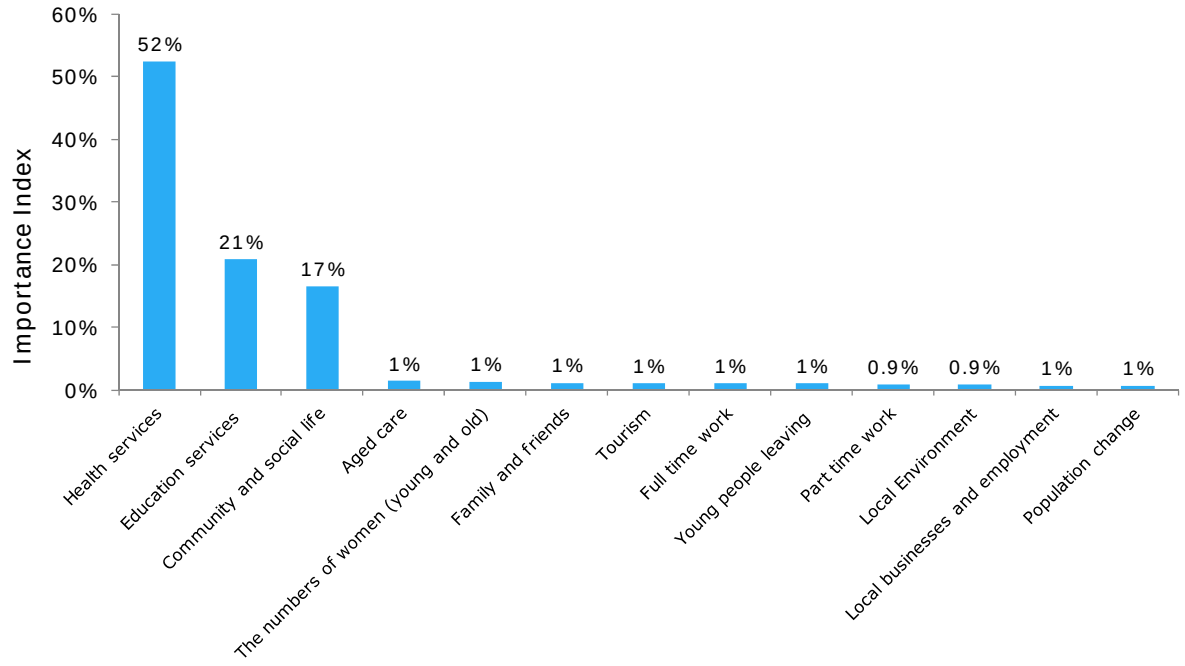
114 *Base: total sample (N=740)*

Figure 84 Key drivers underpinning the decision to stay in a rural community

By contrast, in the scenario of the local school closing, change agents were very likely to say they would definitely leave an area (SR 79.5) while primary producers (SR 34.0) were most likely not to leave the area (X^2 (12) = 7700.9; p<.001). Similarly, in the event that a social service (e.g. welfare

agency) were to close, change agents again were the most likely (84.9) to definitely leave an area (χ^2 (12) = 8726.1; p<.001).

The figure below demonstrates the strength of the result in this study and reinforces many of the findings reported in the previous section. Setting aside the loss of important services and support systems, it can be seen that many other factors which might be considered to impact on a stay/leave decision, in fact have little impact on the overall intention to stay or go.



115 *Base: total sample (N=740)*

Figure 85 Comparative importance of the attributes in the choice model

However, a number of insightful trends were evident in the data. Three distinct options were identified by young workers if they lost their job (18-25 years) (χ^2 (45) = 39143.4; p<.001):

- 14% indicated that they would start a new business (SR 26.0)
- 11% indicated that they would go on the dole (SR 23.6)
- 7% indicated that they would leave the town (SR 32.7)
- 3% indicated that they would get another job locally (SR 10.4).

Similarly, a number of trends were evident amongst workers in their prime working years:

- a fifth of workers aged 35-44 years considered that they would get another job locally (SR 68.8) while a third of workers aged 45-54 years considered that they would get another job locally (SR 53.4)
- over a third (36%) of workers aged 55 – 64 years considered that they would retire (SR 22.7) while two thirds of workers aged 65-74 years considered that they would retire (SR 126.2)

- small business owners were concentrated in the 45-54 year age group; they indicated a high likelihood of trying a different kind of business (SR 25.5).

Among stakeholders, two third (63%) of change agents believed that that they would be likely to find another job locally while others (15%) would leave town. By contrast, a third of primary producers (30.4%) would retire while another quarter (25%) would seek work locally. Of people living in towns, 39% indicated that they would retire and 24% said they would find another job locally. Hobby farmers were quite similar with 34% indicating that they would retire and another 30% believing that they would find work locally.

Chapter 7 - Reason for homeostatic failure in subjective wellbeing

Author: Robert Tanton, Itismita Mohanty and Anthony Hogan

This chapter presents initial results from work being done on the reasons that people experience homeostatic defeat in subjective wellbeing. Subjective wellbeing shows signs of homeostasis, meaning it always gravitates to one number (on average 75 on a scale of 1 to 100). The range around this average is also very small, suggesting that homeostasis is acting as a protective factor for wellbeing.

Homeostatic defeat is when homeostasis stops operating as a protective factor in subjective wellbeing. Homeostatic defeat occurs after challenges to subjective wellbeing become too much for the homeostatic system to deal with.

This paper derives a point of homeostatic failure using data from the Household Income and Labour Dynamics Survey of Australia (HILDA) survey, and then identifies the group of people who have experienced homeostatic failure from one wave to the next of HILDA. Changes in social capital and life events experienced by these people over these two waves are calculated. A logistic regression model is then used to identify which of these changes have a significant effect on homeostatic failure.

We find that, after controlling for changes in social capital and health, only two major life events (birth of a child and separation) have an effect on homeostatic failure. The birth of a child is associated with a lower probability of homeostatic failure; and separation is associated with a higher probability. Worsening of health and a reduction in leisure time are also associated with a higher probability of homeostatic failure. Income was significantly associated with a lower probability of homeostatic failure, so it is a protective factor.

Introduction

The concept of wellbeing is now firmly entrenched in the international literature. Measures of wellbeing go beyond using economic indicators, and include domains like community vitality, governance, psychological wellbeing, health, education, and many others. A recent review of the wellbeing literature has been published in Mohanty and Tanton (2012).

A number of countries now have measures of wellbeing. These countries include Bhutan (The Centre for Bhutan Studies 2012); Australia (Australian Bureau of Statistics 2010b; Cummins 2002); the OECD (OECD 2012) and many more. All these measures go beyond the concept of just considering economic measures of growth like GDP, and include measures like health, education, social networks, etc.

One of the main proponents in recent years of using measures beyond economic growth to measure progress has been the Commission on the Measurement of Economic Performance and Social Progress, which was formed by the French government to:

> "identify the limits of GDP as an indicator of economic performance and social progress, including the problems with its measurement; to consider what additional information might be required for the production of more relevant indicators of social progress; to assess the feasibility of alternative measurement tools, and to discuss how to present the statistical information in an appropriate way." (Stiglitz et al 2009, p. 1)

The members of this commission included Josef Stiglitz, Amartya Sen and Jean-Paul Fitoussi. There were a number of recommendations from this report, but the main one that affects this paper is Recommendation 6:

> "Recommendation 6: Quality of life depends on people's objective conditions and capabilities. Steps should be taken to improve measures of people's health, education, personal activities and environmental conditions. In particular, substantial effort should be devoted to developing and implementing robust, reliable measures of social connections, political voice, and insecurity that can be shown to predict life satisfaction." (Stiglitz et al 2009, p. 15)

This focus on wellbeing and life satisfaction for countries is an extension of psychological research on wellbeing and life satisfaction for individuals. This psychological research uses measures of subjective wellbeing, so a question is asked of an individual and they answer based on a scale. The question asked in the HILDA, an annual longitudinal study run by the Melbourne Institute, is:

> "All things considered, how satisfied are you with your life?"

with a rating of 0 to 10. The other survey that asks questions on subjective wellbeing is the Australian Unity Quality of Life Survey, run by Bob Cummins of Deakin University for Australian Unity. This survey has been run 26 times since 2001, and is currently run about twice a year, with the latest one being Survey 26 from September 2011. The question asked in the Australian Quality of Life survey is:

> "Thinking about your own life and personal circumstances, how satisfied are you with your life as a whole? (0 completely unsatisfied 1 2 3 4 5 neither unsatisfied nor satisfied 6 7 8 9 10 completely satisfied)"

In both HILDA and AQOL, additional questions ask about the respondents satisfaction with a number of other areas of life, and these include home, employment opportunities, financial situation, safety, health, neighbourhood, free time and personal relationships. In the Quality of Life survey, another dimension on spirituality is added (so how satisfied are you with your spirituality), making ten dimensions. All these dimensions can be ranked from 0 to 10. In both surveys, the results for all dimensions can then be summed to get a total score out of 90 (HILDA) or 100 (AQOL). So there are two measures of wellbeing in each survey; a measure of overall wellbeing which is ranked from 0 to 10, and a summary measure of wellbeing for a number of different dimensions in life that can range from 0 to 90 (HILDA) or 0 to 100 (AQOL),

Some international surveys on subjective wellbeing ask respondents to rank how satisfied they are with their life on a scale of 1 to 100 rather than 0 to 10. In this paper, as we use all Australian data, our wellbeing indicators are shown on a scale of 0 to 10,

Some of the research on individual wellbeing is about the stability of subjective measures of wellbeing. Any survey (Australian or International) on subjective wellbeing will give similar results, as shown by Cummins (1995, 1998). These studies show a mean of 7.5 out of 10 75 out of 100) for subjective wellbeing for Western countries and 7.0 out of 10 (70 out of 100) for non-Western countries, with consistent results across different countries.

Other research has been about the stability, or the 'homeostasis' of subjective wellbeing over time (see Cummins 2009). This research, using Australian data, suggests that subjective wellbeing is very stable – it tends to hold within a narrow range of values. Further, subjective wellbeing is homeostatic. This means a number of things, but the main thing it means for this paper is that there is a threshold value which, as this value is approached, the person tries to retain control. If this threshold is breached, the person will, over time, regain control and subjective well being will return to it's normal value for that person. So homeostasis is operating as a protective factor for wellbeing, tending the person back to their "normal" level of wellbeing.

In this chapter, we have used what Cummins calls "homeostatic defeat" (see Cummins 2003, p. 253 and Cummins 2009) and looked at what factors can influence a person suffering homeostatic defeat. Homeostatic defeat is when homeostasis stops operating as a protective factor in subjective wellbeing, and occurs after challenges to subjective wellbeing become too much for the homeostatic system to deal with. These may be some major life events, but could also be other factors that have been shown to have an effect on subjective wellbeing, like health (see Berry 2009).

This chapter shows initial work in this area, and there are many things that still need to be done. We are interested in any comments on the analysis and results from this work.

Section 2 outlines the literature on homeostatic defeat, and identifies where this point may occur by looking at the distribution of wellbeing.

Section 3 looks at the data, and how the different factors have been estimated, including which major life events are associated with homeostatic defeat. Section 4 describes the regression analysis which was done. Section 5 provides a short discussion of the results, and Section 6 outlines future directions of this research, including extending wellbeing to communities, and an analysis of identifying tipping points (see Schelling 1969, 1972) in community wellbeing – so at what level of wellbeing at a community level will the community 'tip' and become unsustainable. The final section provides some conclusions.

Where is the point of failure in homeostasis of wellbeing?

Recent papers by Cummins using the Australian Unity Wellbeing data have identified that subjective wellbeing is very stable. Over a period of 9 years, on a scale of 0 to 10, the subjective wellbeing score had a mean of 7.49 and a standard deviation, once weighted to the whole population, of 1.24. This means that 95% of people in Australia have a value between 5.02 and 9.96 (Cummins 2009).

Looking at another survey which has a measure of wellbeing, the HILDA survey, the distribution of the Wellbeing question in nine waves of the HILDA survey was looked at. The cumulative distribution, mean and standard deviation over these nine waves, and the average across all the waves, is shown in Table 1.

It can be seen that the mean is very similar to the mean of subjective wellbeing from the Australian Unity Wellbeing Survey – about 7.9, compared to about 7.5 for the Australian Unity Wellbeing Survey. The standard deviation is also similar with an average of 1.48 across all waves, compared to 1.24 for the Australian Unity Wellbeing Survey.

Looking at the cumulative frequency distribution, there are very few people with happiness below 3 (on average only 1.55% of the Australian population), but 65% of the population have a value of 7 or above. On average, 15% of the population have a value of 10.

The other point to make about Table 69 is the consistency of the indicator over time. When looking at the distribution, there is not much change in it over the nine waves of HILDA. In Waves 8 and 9, there seem to be slightly fewer people rating wellbeing as 0, and a few more people in Wave 8 and 9 rating their wellbeing as 10 compared to Waves 1 and 2, but the general picture of wellbeing across all the surveys is consistent.

Table 69 HILDA wellbeing cumulative distribution, all 9 waves

	HILDA Wave									
Wellbeing	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Average**
0	0.28	0.17	0.23	0.14	0.10	0.17	0.15	0.04	0.05	0.15
1	0.49	0.36	0.43	0.27	0.25	0.37	0.34	0.18	0.40	0.34
2	1.04	0.90	0.76	0.78	0.71	0.70	0.73	0.69	0.86	0.80
3	1.92	1.71	1.60	1.60	1.41	1.37	1.47	1.29	1.58	1.55
4	3.35	3.24	3.12	2.83	2.55	2.65	2.46	2.19	2.61	2.78
5	8.71	8.81	7.21	7.26	7.16	7.75	6.91	6.17	6.86	7.43
6	14.81	15.10	13.12	13.40	13.67	13.77	13.38	12.57	13.63	13.72
7	32.10	34.58	30.73	31.97	32.88	33.87	33.28	33.10	33.18	32.85
8	61.62	64.98	62.32	63.94	66.15	66.82	67.92	67.70	67.77	65.47
9	80.55	84.60	84.85	85.29	87.11	87.66	88.19	88.70	89.22	86.24
10	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Mean	7.95	7.86	7.96	7.93	7.88	7.85	7.85	7.87	7.84	7.89
Std Dev	1.67	1.61	1.56	1.54	1.50	1.51	1.48	1.43	1.48	1.53

These frequency distributions were then graphed, and are shown in Figure 86. It can be seen from these graphs that the mode (the value with the greatest density) is 8 across all waves of the survey. It appears that in the HILDA survey, the majority of values lie in the range of 7 – 10, and this is confirmed by Table 69. Below 7, there seems to be a sudden drop off in the number of people experiencing wellbeing between 1 and 6.

Looking at the graphs in Figure 86, and the figures in Table 69, it seems that there is a failure in homeostasis when wellbeing is at about 7. The majority of people in Australia have a level above 7 (on average 67% of people in Australia have wellbeing above 7). From the graphs in Figure 86, there appears to be a sudden drop in the proportion of people with a wellbeing of 6 compared to a wellbeing of 7. This suggests that the set point for the operation of homeostasis is at 7, and that below this level there has been a failure in homeostasis.

The reason for this is because for most of their lives, people actively maintain their wellbeing at a level of 7 or above. As the level of life satisfaction falls below 7, this changes (see Cummins 2003), and homeostasis appears to fail. Testing by Cummins using the Australian Unity Wellbeing data identified a resistance line at a wellbeing level of 7 (see Cummins 2003).

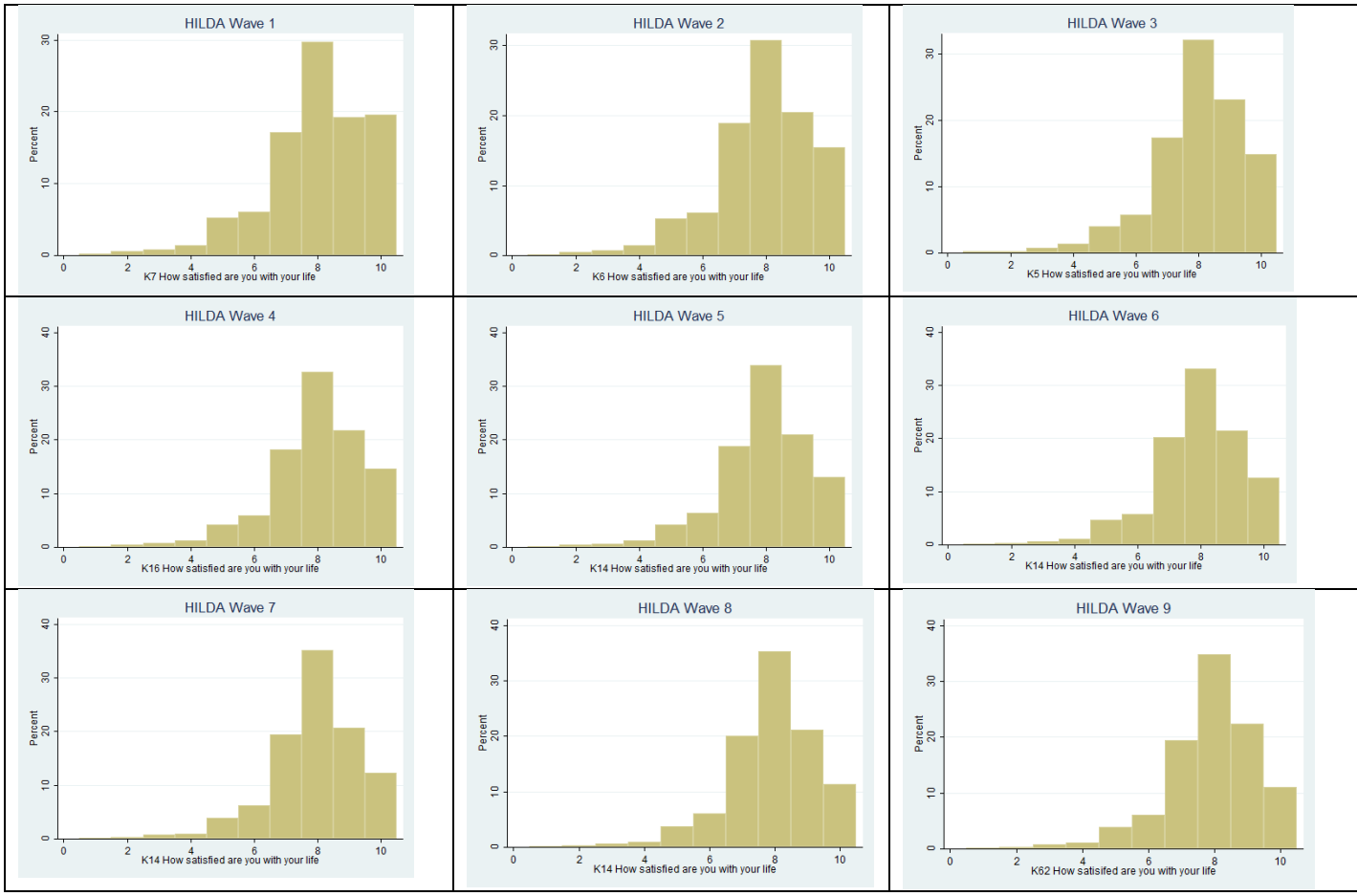


Figure 86 Distribution of wellbeing question from HILDA Wave 1 to 9

We then looked at how far wellbeing changed when homeostatic failure occurred. Because we used HILDA for this analysis, the longitudinal data allowed us to look at how far people fell from one year to the next. We used the change from wellbeing between Wave 8 and Wave 9, and only looked at people who went from above 7 to below 7 on the HILDA scale. Figure 87 shoes the frequency distribution of how far each person that experienced this homeostatic failure fell in terms of their wellbeing. Because we were looking at people going from above 7 to below 7, the minimum change is 2.

It can be seen that the majority of people experienced a change of 2 or 3 points in wellbeing – nearly 75% of people who experienced homeostatic failure fell by 2 or 3 points in wellbeing. The extent of the drop falls significantly after this, with only about 14% of people experiencing a drop of 4 points in wellbeing.

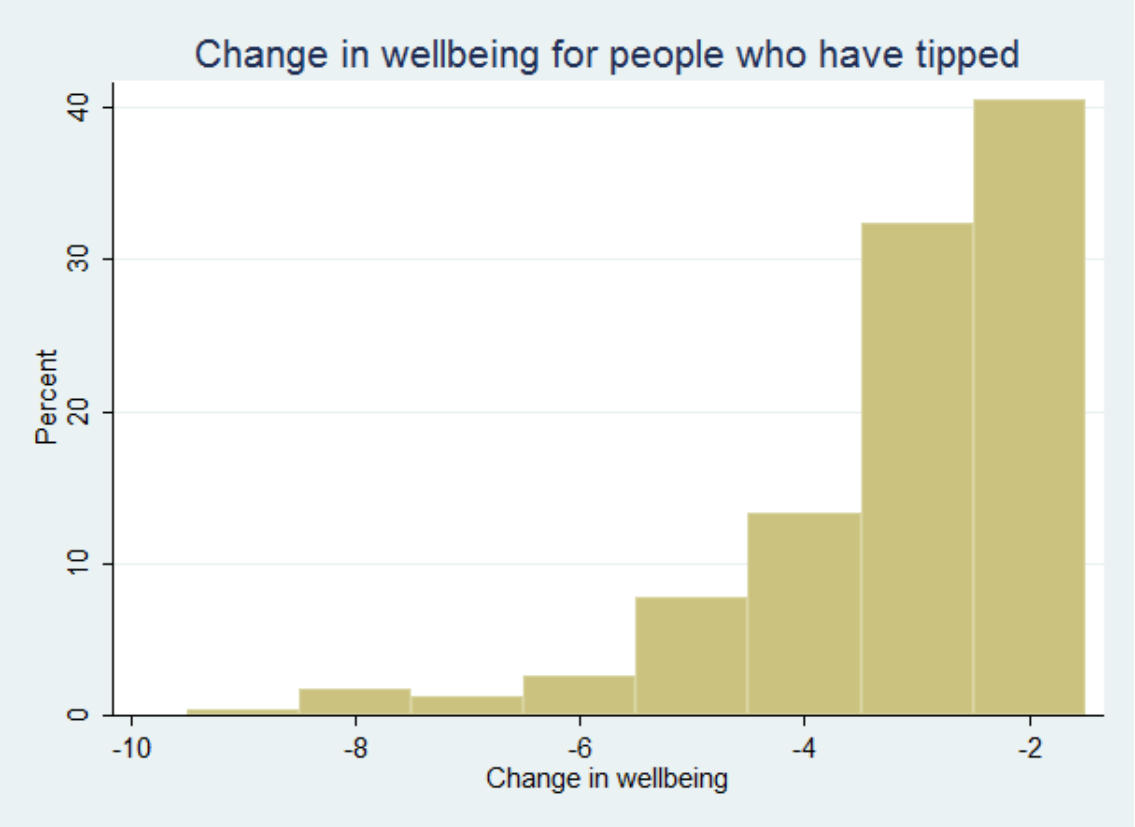


Figure 87 Extent of homeostatic failure

Having identified a level of 7 in the HILDA data for homeostatic failure, the next step was to identify what contributes to this homeostatic failure. This is the topic of Section 4. The next section shows the data used in this analysis.

The Data

To analyse what contributes to a person suffering homeostatic defeat in subjective wellbeing, we have estimated a logistic regression model using two waves of Household Income and Labour Dynamics of Australia (HILDA): wave 8 (2008) and wave 9 (2009). Focusing on the analysis in the preceding section that identifies a value of 7 in the HILDA data for homeostatic failure, the dependent variable in this model is constructed using the overall life satisfaction variable from the HILDA survey. This variable uses the question 'how satisfied the person is in his/her life?'. This variable is based on individual level responses on a Kessler scale (K10) of 0 to 10, where 0 represents the person is totally dissatisfied with life and 10 represents the person is totally satisfied with life. So, the dependent variable identifies individuals whose personal overall wellbeing (how satisfied he/she is with life) has dropped from above 7 in HILDA Wave 8 to below 7 in HILDA Wave 9.

The analysis uses a range of individual and household level characteristics (including equivalised disposable household income) that may contribute to a person's homeostatic failure in subjective wellbeing. The variables used in this analysis include a set of major life events from wave 9 of the HILDA survey, variables representing the change in social capital status of the individual between wave 8 and wave 9, a variable representing a variation in leisure time available to the person between the two waves, a variable representing the worsening physical functioning status of the person (SF 36 scale) in wave 9 compared to wave 8, a variable representing the worsening general health status of the person (SF 36 scale) in wave 9 compared to wave 8, a variable representing the worsening general household health status of the household in wave 9 compared to wave 8, and a variable representing the worsening employment status of the household in wave 9 compared to wave 8.

The set of major life event variables that are included in this model from HILDA wave 9, including the number of valid observations for each major life event, the proportion experiencing this major life event in the sample and the standard error are shown in Table 70.

It can be seen that some serious major life events experienced very low numbers in HILDA (for example, only 63 families experienced a death of a child or a spouse in the last year), and the standard errors around these numbers are high.

In an effort to capture whether experiencing more than one major life event in the previous year would be a significant contributing factor to homeostatic failure in subjective wellbeing rather than each of them individually, we also summarized the major life event variables into one variable representing 'number of major life events in the past year'. This was done by counting the number of major life events that came up as significant in a preliminary analysis involving an ordered probit regression for subjective wellbeing and the set of major life event variables only as independent variables from Wave 9 of HILDA survey. The major life events that were significant in this model were then counted for each person to derive a summary of the number of major life events for our model.

Table 70 Major life events from HILDA

Major life event variables	Number of Observations	% (SE)
person got married in the past year	7004	1.3 (0.117)
person got separated from spouse in the past year	6996	2.4 (0.153)
person had birth/adoption of a new child in the past year	6979	2.3 (0.152)
person suffered serious personal injuries/illness in the past year	6977	9.0 (0.287)
death of spouse/child in the past year	6986	0.9 (0.095)
person had death of close relative/family member in the past year	6987	11.1(0.313)
person was a victim of physical abuse in the past year	6985	0.9 (0.096)
person had retired from the workforce in the past year	7000	2.8 (0.166)
person was fired or made redundant in the past year	6987	3.3 (0.179)
person changed job in the past year	6987	9.0 (0.287)
person had a downfall in finance in the past year	6994	4.1 (0.198)
person changed residence in the past year	6997	11.6 (0.320)
1 or more major life events	6961	23.0 (0.470)

Along with this set of major life event variables, we also included changes in other socio demographic and health characteristics that may serve as potential predictors of homeostatic failure in subjective wellbeing. These were used as control variables for health and social capital, both of which we know have an effect on subjective wellbeing.

In the literature (Berry et al. 2007) the physical health status of the person and physical functioning are very highly correlated with mental health, and for that reason are expected to be a potential determinant of wellbeing. The OECD (OECD 2011) also identifies in their surveys in many countries that people consistently put health status together with employment status on the very top of what affects their living conditions. So, better general health status is not only an objective in itself it is also expected to be a potential determinant of subjective wellbeing and homeostatic defeat in subjective wellbeing.

In this paper we have included two variables to capture the influence of change in general health status between wave 8 and 9 on homeostatic defeat in subjective wellbeing. One variable represents the

change in household health status and the other one is representing the change in individual health status. A variable representing change in individual physical functioning is also used.

The variables representing change in general health status and change in physical functioning of the person are constructed from HILDA wave 8 and 9, using the SF 36 general health transformed and physical functioning transformed variables. The SF 36 general health transformed is a transformed variable in the HILDA survey recoding and summarizing raw health scores from 10 health related items into a transformed subscale of 0 to 100, with high scores indicating better health. This is also the case with the SF 36 physical functioning transformed variable in HILDA.

In order to describe the change in health status and physical functioning status in our analysis, we have had to calculate cut-points to identify the change from 2008 to 2009. A generally accepted score of less than 60 on these two scales represents poor physical functioning and poor general health (Berry & Welsh 2010). Correspondingly, the change in general health status of the person in this paper is a binary variable which is 1 if the person has scored greater than 60 in the SF 36 general health transformed variable in wave 8 and has gone down to less than 60 in wave 9. Likewise, the change in physical functioning status of the person in this paper is a binary variable of 1 if the person has scored greater than 60 in SF 36 physical functioning transformed variable in wave 8 and has gone down to less than 60 in wave 9.

The variable representing change in household health status in this model is generated from HILDA wave 9 using the variable representing the health of the person compared to one year ago. The original variable in the HILDA survey is reported on a scale of 1-5, where 1 is much better now than a year ago, 2 is somewhat better now than a year ago, 3 is about the same as one year ago, 4 is somewhat worse now than one year ago and 5 is much worse now than one year ago. In our model the household health status is considered worse than one year ago if in wave 9 the reported response for the person is greater than 3. So, the household health status variable in this model is categorical and constructed at the household level representing 0 if no one in the household suffers from worse health condition compared to one year ago, 1 if one person in the household suffers from worse health condition and 2 if two persons in the household suffer from worse health condition.

The household employment status variable in this model is generated from the HILDA wave 9 individual employment status (ihges). In HILDA the individual employment categories are: 0 less than 15 years old, 1 full time employed, 2 part time employed, 3 not employed but is looking for work, 4 retired, 5 home duties, 6 non-working student and 7 other. Correspondingly, in this model the household employment status variable is a binary variable calculated as a 1 if a household has at least 1 unemployed person and 0 employed people. The change in employment status is calculated as a change from 0 in Wave 8 to a 1 in Wave 9.

Social capital has been emerging as an area of great interest to planners, policy makers and community and welfare organisations around the world as potentially important determinant of wellbeing. This is believed to be powerful enough to offset some of the disadvantages of other forms of capital (Semo 2011). In the literature social capital has been positively associated with better health, education, productivity and civic participation and also reduced poverty, crime and social exclusion (Putnam 2000).

However, Social capital is intangible in nature and is a complex and diverse concept to identify and capture its influence on subjective wellbeing. It is mostly realised through interactions between family members, friends, neighbours and formal social relationships and associations such as in educational institutions, clubs and workplaces. These interactions help to develop values such as trust and reciprocity that have the potential to positively influence wellbeing. For the purpose of this research we have conducted factor analysis on a range of variables from HILDA waves 8 and 9 to identify the relationship between social capital and individual wellbeing.

However, it is difficult to then to capture the change in social capital status of an individual between these two waves that would potentially explain the homeostatic defeat in subjective wellbeing.

Because of this, we have simplified the concept of social capital somewhat and have used 'change in satisfaction level of the person with the available amount of free time' and the 'change in voluntary work hours of the person' between these two waves. The variable representing the change in satisfaction level of the person with the available amount of free time in this model is constructed using the variable on satisfaction with the amount of free time the person has in both the waves (losatft). These variables are reported on a Kessler 0-10 scale in HILDA, where 0 represents totally dissatisfied, 5 represents neither satisfied nor dissatisfied and 10 represents totally satisfied. So, the change in satisfaction level of the person in this model is a binary variable, where 1 identifies a person's satisfaction level of more than 7 in wave 8 and less than 7 in wave 9 with the available amount of free time. This cutoff was identified by looking at a frequency distribution of this variable.

The change in voluntary work hours (combined hours/minutes per week voluntary charity work) is a binary variable in this model where 1 identifies individuals that have done some positive hours of voluntary work in wave 8 and have done no hours of voluntary work in wave 9.

A list of these variables, how they were derived, and the number of observations, mean and standard error are presented in Table 71.

Table 71 List of other control variables used in the model

Variables	Number of Observations	Mean (SE)
Change in physical functioning (SF36 scale) (Physical functioning is worse in 2009)	6630	0.060(0.238)
Change in general health status (SF36 scale) (Health status is worse in 2009)	7073	0.088(0.284)
Change in leisure time (Satisfied with leisure time in 2008 but dissatisfied with leisure time in 2009)	7696	0.065(0.247)
Change in amount of voluntary work hours (decline in amount of positive voluntary work hours in 2008 to no voluntary work at all in 2009)	6165	0.167(0.373)
Change in household health status – 1, 2 or 3 people in household changed	7721	0.373(0.588)
Change in employment status in the household to at least 1 person unemployed and no-one employed	7721	0.015(0.123)
Equivalised disposable household income in 2009	7721	44.15(30.462)

The next section discusses the econometric analysis to identify which of these factors contribute to homeostatic defeat.

What contributes to homeostatic defeat?

This section uses a logistic regression model to identify what variables affect homeostatic failure. The regression model used is a logistic regression model of homeostatic failure, so we use two waves of the HILDA dataset. For this analysis, we have used Wave 8 and Wave 9. The dependent variable is whether an individual has moved from 7 or above in Wave 8 to below 7 in Wave 9. We have called this HF, or Homeostatic Failure.

The independent variables are all variables that may affect whether an individual experiences a reduction in wellbeing. The variables we have used are major life events in HILDA (Married, Separated, Birth, Serious personal injury/illness, serious injury to family member, death of spouse/child, death of other family member, victim of physical abuse, retired from workforce, fired or made redundant, changed residence) and indicators of social capital.

Homeostatic defeat in wellbeing tends to be due to not just one life event, but a number of events happening together. We have therefore converted the life events into a number of life events happening to a particular person from wave 8 to wave 9 of the HILDA survey. This was done by counting the number of major life events that has occurred for each person from Wave 8 to Wave 9 of HILDA. This summarised the life events into one variable.

We may also surmise that some life events are larger than others – so for example, a death in the family may be more significant than losing a job. In future work, we could look at deriving weights for each major life event (possibly from a regression model) and then use these weights to derive a weighted major life event indicator. Another extension could be to look at life events over the past 2 – 3 years rather than the past year, again weighting them according to their impact on wellbeing.

Literature also suggests that health has a significant impact on wellbeing (see Berry & Welsh 2010), so we have included change in health status. We have also included some social capital variables, as social capital also has an impact on wellbeing. The social capital variables we have included are change in leisure time, change in voluntary work and change in employment status, as all these variables may be associated with changes in wellbeing (see ABS 2001; Thoits and Hewitt 2001).

Cummins (2009) also suggests that money also acts as a protective factor against homeostatic failure. Those with higher incomes can use money to reduce the impact of factors that may be associated with homeostatic defeat, thus protecting themselves to some extent from homeostatic defeat. We have therefore included income in 2009 (so not change in income as we want to incorporate income as a protective factor).

In future work, we will also look to summarise some of these social capital variables into a number of summary factors using factor analysis, similar to the work of Berry et al (2010). The issue we found with this approach was identifying what change in a social capital summary factor from one year to the next was enough to contribute to homeostatic failure. This could be done with a statistical comparison of the changes in the social capital summary factors.

The next step is a logistic regression model of homeostatic defeat with the number of major life events, and change in health and social capital variables from wave 8 to wave 9 to identify which variables have the greatest impact on the likelihood of homeostatic defeat. This model used the replicate weights from HILDA to calculate standard errors and measures of significance.

The results from this model are shown in Table 4.

Table 72 Regression of homeostatic defeat, change in health, change in social capital and major life events

Variable	Odds Ratio	P > |t|
Number of major life events in the last year	1.384	0.155
Change in physical functioning (SF36 scale) (Physical functioning is worse in 2009)	0.934	0.850
Change in general health status (SF36 scale) (Health status is worse in 2009)	2.294	0.006
Change in leisure time (Satisfied with leisure time in 2008 but dissatisfied with leisure time in 2009)	3.372	0.000
Change in amount of voluntary work (Satisfied with amount of voluntary work in 2008 but dissatisfied in 2009)	0.534	0.112
Change in household health status – 1, 2 or 3 people in household changed	2.018	0.000
Change in employment status to at least 1 person unemployed and no-one employed	2.432	0.191
Equivalised disposable household income in 2009	0.985	0.002

It can be seen that the significant variables (at the 5% level) were change in health status, change in leisure time, change in household health status and income. The odds ratios were all positive, meaning

The number of major life events in the last year was insignificant after controlling for other variables that may influence wellbeing. One of the problems with this variable was that 70% of those who experienced homeostatic failure in the last year experienced no major life event (see Figure 88), so the homeostatic failure is associated with something else (possibly the variables identified as significant in Table 72).

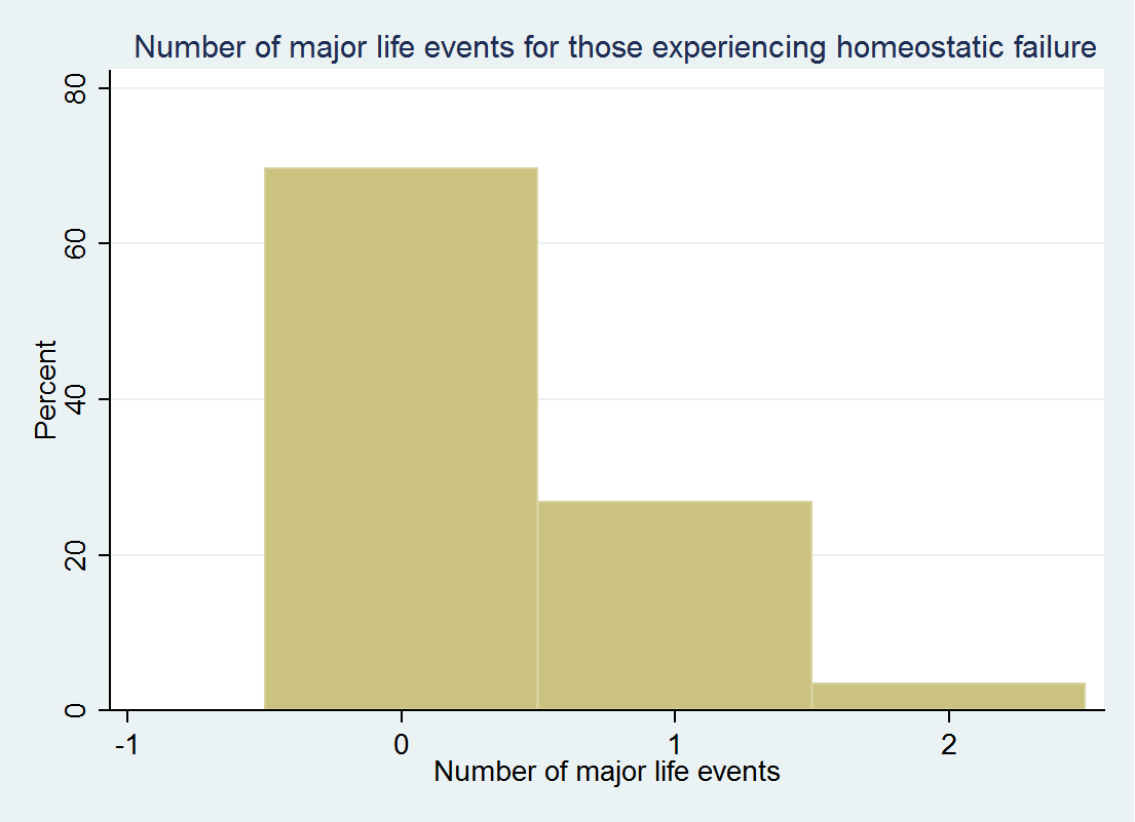


Figure 88 Number of major life events for those experiencing homeostatic failure

The next step was to look at whether any major life events in particular were associated with homeostatic failure. To do this, we ran a regression with each of the major life events identified separately, along with the other indicators of health and social capital that we used for the model shown in Table 72. The results from this analysis are shown in Table 73.

Table 73 Results of logistic regression with all major life events separately

Variable	Odds Ratio	P > |t|
Married	0.592	0.221
Separated	4.807	0.001
Birth of a child	0.293	0.000
Serious personal injury/illness	1.646	0.184
Serious injury/illness of family member	0.826	0.600
Death of spouse or child	1.813	0.591
Death of close relative/family member	0.658	0.281
Victim of physical violence	1.334	0.765
Retired from workforce	1.340	0.531
Fired or made redundant	1.671	0.485
Changed jobs	1.509	0.357
Major worsening in finances	1.026	0.955
Changed residence	0.525	0.238
Reduction in physical functioning (SF36 scale)	0.888	0.746
Reduction in general health status (SF36 scale)	2.235	0.011
Change in leisure time (Satisfied with leisure time in 2008 but dissatisfied with leisure time in 2009)	3.450	0.000
Change in amount of voluntary work (Satisfied with amount of voluntary work in 2008 but dissatisfied in 2009)	0.578	0.194
Change in household health status – 1, 2 or 3 people in household changed	2.019	0.000
Change in employment status	2.108	0.376
Equivalised disposable household income in 2009	0.985	0.001

Comparing Table 72 and Table 73, it can be seen that identifying the major life events separately had little impact on the results for the other variables. While the odds ratios for some variables have changed slightly, none of the significance levels have changed at the 5% level. The P > t has increased for the change in employment status, but this was also insignificant at the 10% level in Table 72.

The two major life events that were significantly associated with homeostatic failure were being separated; and the birth of a child. Other factors that were associated with homeostatic failure were change in health; change in leisure time; change in household health status; and income. Becoming separated, worsening health, less leisure time, and more people in the household changing health status were all associated with a higher probability of homeostatic failure. The birth of a child was associated with a lower probability of homeostatic failure. Income also had a significant effect on the probability of homeostatic failure, and slightly reduced the probability of homeostatic failure, so it acts as a protective factor.

Discussion of results

The results in Table 73 suggest that once we control for changes in social capital and health (both of which have been shown to affect wellbeing – see ABS 2001; Berry & Welsh 2010), there are two life events that affect wellbeing – getting divorced and having a baby. None of the other life events (like death of a relation, victim of physical violence, being fired or moving) had a significant effect on wellbeing once changes in social capital and health are controlled for.

Further, the number of life events in the past year doesn't appear to have a significant effect on wellbeing – it is merely whether a particular life event (separation or birth of a child) occurred. This

requires some more research looking at significant life events over a longer term, and this research is outlined in Section 6.

A change in leisure time from satisfied to dissatisfied was associated with a significant increase in the probability of homeostatic failure. This could be to do with a change in life circumstances, for example, changing to a more stressful job

The result showing that separation is associated with homeostatic failure is consistent with Cummins (2009), which showed that relationship support is a highly effective buffer for homeostatic failure.

Cummins (2009) also found that income was a protective factor in homeostatic failure, and this model confirms this, although the effect is very small. This is an interesting result, as we did expect income to have more of an effect on the probability of homeostatic defeat, although it may not be a protective factor against the types of factors that do contribute to a higher probability of homeostatic defeat in this model (separation, change in health status).

Future Work

While observing homeostatic defeat in frequency distributions of individual wellbeing, one interesting question that we have not been able to answer in this paper due to limitations in the geographic detail of the data is what contribution does individual wellbeing have on community wellbeing? And at what level does community wellbeing become so low that people leave?

To do this analysis, we need information on wellbeing at the community level, and we expect to get this through surveys conducted with the Cotton CRC of areas in the Murray-Darling Basin. Using these data, we hope to use statistical methods to identify the "tipping point" in community wellbeing.

The theory of tipping points comes from Schelling (1969, 1972), in his study of racial segregation and has been popularised by Malcolm Gladwell's book (Gladwell 2001). A tipping point is "the moment of critical mass, the threshold, the boiling point" (Gladwell, p. 12). In the context of community wellbeing, it can be seen as the point of community wellbeing where the stream of people leaving the area becomes a flood, and the area becomes unsustainable.

One statistical method to identify a tipping point uses a regression-discontinuity approach, which requires some estimate of the tipping point for small areas; and observations from a number of areas. Another method uses techniques borrowed from the literature identifying trend breaks in time series data, Card et al (2006) identified tipping points in segregation in neighbourhoods and schools using this method. Further work using data collected through the Cotton CRC project, will use these methods to identify the tipping points for communities, and then what factors affect these community level tipping points.

Other further work that we would like to do is around the influence of major life events. We would expect the effect of major life events on wellbeing to diminish over time, but this will occur at different rates for different events. So the effect on wellbeing of having a baby may last for one year; but the effect of a death in the family may last for a number of years. There may also be a 'residual' effect of a major life event, so a death in the family may not affect wellbeing immediately but then when a second person dies 2 years later, the person may be more likely to suffer homeostatic defeat compared to someone who has only had one death in the family.

Conclusions

While other work like Berry (2009) has been on what factors influence wellbeing, this paper has taken a slightly different approach and looks at what factors influence homeostatic defeat. This is the first study that we know of in Australia that has considered a statistical model of what affects homeostatic defeat.

What we find is that two major life events affect the probability of homeostatic defeat. Having a baby reduces the probability of homeostatic defeat, and separation increases the probability. Worsening health status and decreasing leisure time also have a significant effect on increasing the probability of homeostatic defeat.

Income is also a protective factor for homeostatic defeat, reducing the probability slightly.

Interestingly, major life events like death of a relative and death of a child had no significant impact on homeostatic defeat, so homeostasis continues to support wellbeing after these major life events.

This work reinforces the impact that separation has on a person's wellbeing, and the impact on the rest of a family's wellbeing that a new baby brings.

General caveat

NATSEM research findings are generally based on estimated characteristics of the population. Such estimates are usually derived from the application of microsimulation modelling techniques to microdata based on sample surveys.

These estimates may be different from the actual characteristics of the population because of sampling and nonsampling errors in the microdata and because of the assumptions underlying the modelling techniques.

The microdata do not contain any information that enables identification of the individuals or families to which they refer.

Appendices

Appendix A NetLogo code for ‘no change’scenario, Waikerie

```
globals [year]

turtles-own [
  sex
  lfsp
  age
  years_in_town
  children
  working_age
  birth
  bfloat
  migprob
  repprob
  deathage
  death
  ageclass10
  maternalage
  out?
]

patches-own [
  empty
]

To initialise
  import-pcolors "picture river5.bmp"
end

To setup
 clear-turtles
  file-close-all
    ask n-of 4475 patches with [pcolor != 93.2] [sprout 1 [set size 1.5
    set shape "person"]]
    set year 0
  set-current-plot "age distribution"
  set-plot-y-range 0 (round (count turtles / 3))
  set-current-plot "population"
  set-plot-y-range 0 (count turtles + 200)
end

To create_population
    reset-ticks
  file-open "testInput.txt"
  ask turtles [
  set sex file-read
  set lfsp file-read
  set age file-read
  set years_in_town file-read
  set children file-read
   ]
  file-close
  ask turtles [if sex = 1
    [set color blue - 2]]
  ask turtles [if sex = 2
    [set color magenta + 1
```

```
      set shape "she-person"]]
  ask turtles with [age > 14] [set size 3]
  ask turtles [set ageclass10 (age + 1) / 10]
  set-current-plot "age distribution"
  histogram [ageclass10] of turtles
 ; histogram [children] of turtles with [sex = 2 and age > 14]

  ; plot the population size
  set-current-plot "population"
  plot count turtles
 end


To go
  ask turtles with [pcolor = 93.2]
  [ move-to one-of patches with [pcolor != 93.2]]
  ask turtles [
    set deathage 0
    set ageclass10 0
    set maternalage 0]

  if ticks > 19 [stop]

   tick
     give-birth
     arrive
     set year year + 1
     ask turtles [
    set age age + 1; age one year
    set years_in_town years_in_town + 1; be in town one extra year
   ]
         if ticks > 1 [drop-off
     leave]
      draw-plots
end

to give-birth

  ask turtles with [sex = 2] [set maternalage (age - 14) / 5]
  ask turtles with [maternalage > 0 and maternalage < 6.2] [
    set birth (-0.0015 * maternalage ^ 3) - (0.0007 * maternalage ^ 2) +
(0.0694 * maternalage) - 0.0707]
      ask turtles with [children > 0] [set birth birth * (0.0214 * children
^ 2 - 0.2986 * children + 1.09)]
   ask turtles [set bfloat random-float 1]
  ask turtles with  [bfloat < birth]
  [set children children + 1]
  ask turtles with  [bfloat < birth]
    [hatch 1 [
      ifelse random-float 2 < 1.04
    [set sex 1]
    [set sex 2]
    set age 0
    set years_in_town 0
    set size 1.5
    set lfsp 2
    set children 0
    setxy random-xcor random-ycor]]
 ask turtles [if sex = 1 and age = 0
       [set color blue - 2]]
    ask turtles [if sex = 2 and age = 0
```

```
    [set color magenta + 1
     set shape "she-person"]]
 ask turtles with [pcolor = 93.2]
  [ move-to one-of patches with [pcolor != 93.2]]

    end


to drop-off
  ask turtles [set deathage (age - 4) / 5]
  ask turtles with [sex = 1 and age = 0] [
    set death (random-float 0.001) + 0.005
    if random-float 1 < death
    [die]
    ]
  ask turtles with [sex = 2 and age = 0] [
    set death (random-float 0.001) + 0.003
      if random-float 1 < death
    [die]
    ]
   ask turtles with [sex = 1 and age > 0 and age < 5] [
    set death (random-float 0.0001) + 0.0002
    if random-float 1 < death
    [die]
    ]
   ask turtles with [sex = 2 and age > 0 and age < 5] [
    set death (random-float 0.0001) + 0.0001
      if random-float 1 < death
    [die]
    ]
 ask turtles with [sex = 1 and deathage > 0] [
    set death (0.00005 * deathage ^ 3) - (0.0008 * deathage ^ 2) + (0.0039
* deathage) - 0.0045
    if random-float 1 < death
    [die]
    ]
 ask turtles with [sex = 2 and deathage > 0] [
    set death (0.00003 * deathage ^ 3) - (0.0006 * deathage ^ 2) + (0.003 *
deathage) - 0.0035
    if random-float 1 < death
    [die]
 ]
end


to leave
  ask turtles [set ageclass10 (age + 1) / 10]
  ask turtles with [sex = 1 and age > 0] [
    set migprob (0.002 * ageclass10 ^ 3) - (0.031 * ageclass10 ^ 2) +
(0.1225 * ageclass10) - 0.018
    if random-float 1 < migprob
    [die]
  ]
  ask turtles with [sex = 2 and age > 0] [
    set migprob (0.0008 * ageclass10 ^ 3) - (0.0131 * ageclass10 ^ 2) +
(0.0529 * ageclass10) + 0.0461
    if random-float 1 < migprob
    [die]
  ]
end
```

```
to arrive
  ask turtles [set ageclass10 (age + 1) / 10]
  ask turtles with [sex = 1 and age > 0] [
    set repprob (0.0004 * ageclass10 ^ 3) - (0.0062 * ageclass10 ^ 2) +
(0.0121 * ageclass10) + 0.1027
    if random-float 1 < migprob
   [hatch 1
     set years_in_town 0
     setxy random-xcor random-ycor]
  ]
  ask turtles with [sex = 2 and age > 0] [
    set repprob (0.0011 * ageclass10 ^ 3) - (0.0174 * ageclass10 ^ 2) +
(0.0616 * ageclass10) + 0.0522
    if random-float 1 < migprob
    [hatch 1
      set years_in_town 0
      set children random 3
      setxy random-xcor random-ycor]
  ]
 ask turtles with [pcolor = 93.2]
  [ move-to one-of patches with [pcolor != 93.2]]
end


To draw-plots
   ; plot the age distribution
  set-current-plot "age distribution"
  histogram [ageclass10] of turtles

  ; plot the population size
  set-current-plot "population"
  plot count turtles

end
```

Appendix B Methodological background to this study

This quantitative study involved a two-staged methodology. Stage I of the survey involved a computer aided telephone interview (CATI) survey of 2000 respondents from across the three areas of interest; Namoi, Riverland and St George areas. The main components of the survey were:

1. subjective wellbeing (Cummins 2009)
2. cumulative index of recent stressful events
3. financial and emotional impacts of significant weather events
4. questions on individual adaptive capacity (Schwarzer and Jerusalem 1995)
5. questions on collective adaptive capacity including community leadership (Paton, Burgett and Prior 2008)
6. social connectedness (Bhutan 2012; McIntosh et al. 2008; Cummins et al. 2003; Salvaris 2000)
7. work life balance (Karasek 1979)

8. natural resource condition (Department of Environment, Climate Change and Water (2009)
9. water usage (Department of Environment, Climate Change and Water (2009)
10. demographic items.

A copy of the survey instrument can be found at the end of this report.

Sampling and data collection

The sampling frame for the study was based upon previous research designs used for Namoi Catchment Management Authority (CMA) projects (see for example Ipsos 2007 & 2010). These research designs recognised key stakeholder groups within the rural community (farmers, hobby farmers, town residents and change agents) and conduct address research concerning natural resource management taking into account the views of these respective groups. The Namoi CMA was a major supporter of this study and requested that the research design used in this study be consistent with their earlier designs. To this end the sampling for this study was structured to capture the range of views of these stakeholders with regards adaptability and change in the face of changing climate, water policy and the viability of family farming in agri-dependent communities. The telephone survey then drew 2,000 people covering the key target audiences on the following basis:

- primary producers/natural resource managers n=400 (Source: a list representing the primary producer and natural resource manager population)
- community – town dwellers n=1000 (Source: random digit dialling)
- community – rural dwellers n=500 (Source: random digit dialling)
- change agents n= 100 (Sample: sourced from a list)

The figure below provides data on the final sample design.

Namoi Catchment area

LGA	Primary producers		Town residents		Hobby Farmers		Change Agents		Total	
	No	Percent	No	Percent	No	Percent	No	Percent	No	Percent
Tamworth incl Walcha	75	30%	330	60%	60	60%	60	60%	600	60%
Gunnedah Warrumbungles	63	25%	83	15%	15	15%	15	15%	150	15%
Liverpool Plains	38	15%	44	8%	8	8%	8	8%	80	8%
Narrabri	63	25%	77	14%	14	14%	14	14%	140	14%
Walgett	13	5%	17	3%	3	3%	3	3%	30	3%
Total	250	25%	550	55%	100	10%	100	10%	1000	100%

And in the St Georges and Waikerie area:

	Primary producers	Town residents	Hobby Farmers	Change agents	Total
St George	100	250	125	25	500
Waikerie	100	250	125	25	500

11

Figure 89 Sampling frame for this study

The methodology used to capture the base sample was:

- stage 1: computer assisted telephone interviewing (CATI), with all questions and required skips preprogrammed
- stage 2: online or self complete survey containing the choice model glossary and tasks.

The CATI interview lasted 20 minutes. The CATI interview was also used to recruit respondents to conduct a second stage survey by either an online or postal method. This second survey was a discrete choice model which examined peoples' preferences for remaining in or leaving their specific communities. This study examined 13 elements about a local community which may be considered important in whether a person and their family decided to stay in a rural town or leave it. These factors were the growth of local business in the area, level of employment (full and part time) the number of young people leaving the area, the number of women (young and old) living in the area, friends and family living in the area, overall population change, community life, access to education and health service, access to aged care, tourism and the state of the environment. The discrete choice experiment requires people to examine a series of six possible rural scenarios and to decide on the basis of that scenario, whether or not they would stay in or leave the community. As the scenarios needed to be visually examined, the study required respondents to see visual stimulus (namely the 6 discrete choice hypothetical scenarios).

The table below reports on the actual sample obtained. As is evident from the table, some minor oversampling occurred in St George (n=657) and Waikerie (n=525). This occurred as a result of the process of random digit dialling which was utilised in this study. Within this design the first four digits of the telephone number are held constant, to capture residents in a given area, while the last four digits are randomly dialled to capture households within the targeted area. As a result of increasing centralisation of telephone systems in rural areas, numbers with the same leading four digits may in

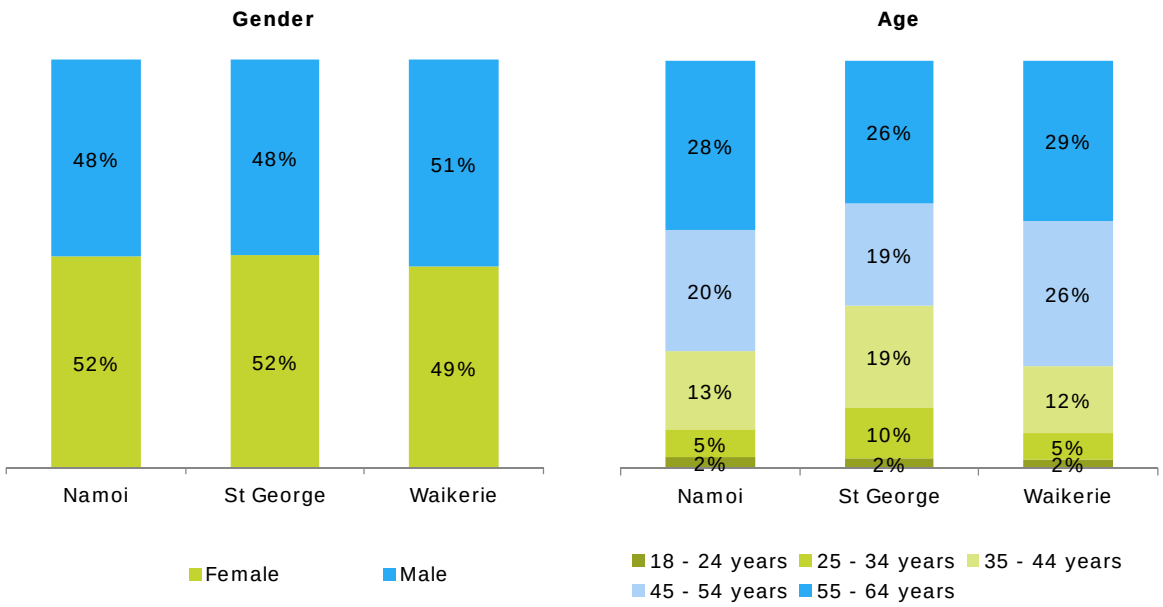
fact capture residents from both the targeted community and those in neighbouring areas. This outcome occurred in this study.

	N = 2196	%
Namoi		**46**
Tamworth incl Walcha		24
Gunnedah Warrumbungles		8
Liverpool Plains		4
Narrabri		8
Walgett		2
St George		**30**
St George		23
Outside of St George		7*
Waikerie		**24**

Figure 90 Sample captured for this survey

Eligible participating respondents were people aged 18 – 74 years. The figure below provides basic demographic data for the respondents. The age profile of the sample is skewed towards the older age group, reflecting the known age profile of rural communities (Hogan et al. 2008).

On these respondents, 740 agreed to complete the choice model survey.



16 *Base: Total Sample - Namoi (n=1014), St George (n=657*), Waikerie (n=525)*
** Includes additional sample*

Figure 91 Survey participants by gender and age

The figure below provides data on the employment status of respondents.

		Namoi (n=1014) %	St George (n=657*) %	Waikerie (n=525) %
Employment situation	Self employed	26	38	23
	Employed for wages, salary or payment in kind	32	33	35
	Unemployed and looking for work	2	1	1
	Engaged in home duties	3	3	2
	Full time student	0	0	0
	Retired	32	20	32
	Unable to work (not due to age)	5	4	5
	Other	1	1	2
	Working group	Namoi (n=588) %	St George (n=463*) %	Waikerie (n=308) %
Type of work	Full time	69	75	58
	Part time	22	17	24
	Causal	7	7	13
	Contract	2	1	5

** Includes additional sample*

Figure 92 Employment status of survey participants

Data weighting

After considerable discussion within the research team and the sponsors of this study, the decision was taken not to weight the data to the population for the purpose of analysis and reporting. The sample design was based on two studies previously conducted by IPSOS Research and first and foremost the study design needed to be consistent with this research. Moreover and from a technical perspective, robust arguments were put forward as to why the data should not be weighted.

First and foremost, it is important to consider whether data should be weighted at all. While weighting is a useful tool, the preference is always not to weight. Statistical formulas for standard deviation and margin of error are all based on the proportional relationship between sample and population. Once the data is weighted, the computation of these measures becomes more messy whilst not adding a lot of value. Data can be weighted for a number of reasons. A study may produce some unexpected sampling results, and the weighting is applied to adjust for any disproportionate sampling based on the population. Similarly if one is undertaking a national survey and the results need to be representative of the entire population, the data may be weighted, for example by sex and age.

In this communities study, sampling quotas were deliberately used. These focused on seeking the inputs of members of four key groups whose views and behaviours were considered to central to how their communities might adapt in the face of change. In addition, in this study we are comparing 3 different communities. The main reason that weighing has not been applied is because each area is distinct and we are not doing a total population survey. The sample size of each area has already been taken into account when comparing the areas with statistical significant tests. Moreover, because we

did not want to overemphasize the opinions of certain areas (or groups of respondents) relative to others, we chose not to weight the data. The sample taken from the population in Namoi in this study was deliberately larger than St George and Waikerie; at the end of the day Namoi would have a larger voice in the study than St George and Waikerie if we use weighting. A similar argument could in turn be extended to the nature of the participants in the study. While change agents, for example, are small in number, they may in fact be the most influential in terms of decision making. We did not wish to distort the contribution made by respective respondents by adding in weights.

Psychometric properties of scales and indicators derived from the survey

The items of the Deakin Wellbeing Index were utilised as per the protocol provided by Cummins et al. (2002). Exploratory factor analysis was conducted on each of the remaining survey components. As Berry &Welsh (2010) observe, 'exploratory factor analyses helped identify the structure of complex underlying or 'latent' concepts, thereby indicating how many concepts the dataset contained, which items 'belonged' in the concept, and to what extent they were representative of that concept (that is, how heavily they load statistically on the factor). Ten factors were identified from the analysis of the survey. Specifically:

1. subjective wellbeing e.g. How satisfied are you with what you are currently achieving in life?
2. individual adaptive capacity e.g. I can solve most problems if I invest the necessary effort
3. community connectivity e.g. I always feel that I am an important part of this community
4. access to social support e.g. I am able to get support from family and friends when needed
5. ability to work together e.g. The people in this community can work together even when it requires more than normal effort
6. efficacy of community leadership e.g. our Council is note very effective
7. perceptions of natural resource condition e.g. There are enough shrubs and grasslands in the region to support native birds, animals and plants
8. perceptions of importance of water for the environment e.g. provision of water for the environment is equally as important as provision of water for agriculture, towns and industry.

Table 74 below reports the items which loaded onto the Deakin Wellbeing Index, along with their respective statistical loadings.

Table 74 Items loading on the Deakin Wellbeing Index

	Item	Factor loading
Deakin wellbeing Index	Satisfied with life as a whole	.836
	Satisfied with your standard of living	.787
	Satisfied with what you are currently achieving in life	.770
	Satisfied with your future security	.618
	Satisfied with your health	.614
	Satisfied with feeling part of the community	.575
	Satisfied with your personal relationships	.575
	Satisfied with how safe you feel	.500

Table 75 below reports the items which loaded onto the indicator for Individual Adaptive Capacity, along with their respective statistical loadings.

Table 75 Items loading on the indicator for individual adaptive capacity

	Item	Factor loading
Individual adaptive capacity	I can solve most problems if I invest the necessary time	.766
	Thanks to my resourcefulness, I can handle unforeseen situations.	.734
	I can handle whatever comes my way	.639
	When I am confronted with a problem, I can usually find several solutions	.618
	I can always manage to solve difficult problems if I try hard enough	.610

Table 76 below reports the items which loaded onto the indicator for Collective Adaptive Capacity (ability to work together) along with the respective statistical loadings for the items.

Table 76 Items loading on the indicator for collective adaptive capacity - ability to work together

	Item	Factor loading
Ability to work together	The people in this community can work together even when it requires more effort than normal	.760
	The community can present a united vision to outsiders	.700
	We can resolve crises in this community without any negative after effects	.667
	Our community can co-operate in the face of difficulties to improve the quality of community facilities	.649
	The members of this community talk about issues they are interested in	.517

Table 77 below reports the items which loaded onto the indicator for Collective Adaptive Capacity (ability to work together), along with the respective statistical loadings for the items.

Table 77 Items loading on the indicator for collective adaptive capacity - lack of community leadership

	Item	Factor loading
Lack of community leadership	Our local council is very effective in planning for our community	.570
	Our community has a strong leader who would lead us through significant changes e.g. climate variability and drought, global economic, and industry change	.354

Table 78 below reports the items which loaded onto the indicator for Social Capital (feeling safe in the community), along with the respective statistical loadings for the items.

Table 78 Items loading on the indicator for social capital – community connectivity

	Item	Factor loading
Community connectivity	I always feel I am an important part of this community	.671
	This community accepts people from different cultures and backgrounds	.521
	I am able to get help from family and friends when needed	.470
	I have opportunities to participate in affordable local arts and cultural activities if I want to	.427

Table 79 below reports the items which loaded onto the indicator for Social Capital (social support), along with the respective statistical loadings for the items.

Table 79 Items loading on the indicator for social capital – social support

	Item	Factor loading
Social support	If I could not drive I would be able to get to the nearest major regional centre using other means e.g. public transports, friends and family members	.641
	I am able to get help from family and friends when needed	.460

Table 80 below reports the items which loaded onto the indicator of Perceptions of Natural Resource Condition along with the respective statistical loadings for the items.

Table 80 Items loading on the indicator for perceptions of natural resource condition

	Item	Factor loading
Perceptions of biodiversity outcomes	There are enough shrubs and grasslands in the region to support native birds, animals and plants	.953
	There are enough trees in the regional landscape to provide sufficient food and shelter for native plants and animals	.856
	Sufficient resources have been allocated to protect endangered plant and animal species in this area	.757

Table 81 below reports the items which loaded onto the indicator of Water Usage along with the respective statistical loadings for the items.

Table 81 Items loading on the indicator for perceptions of support for water for the environment

	Item	Factor loading
Water usage	It is important to protect and manage the remaining wetlands in the region	.731
	Provision for water for the environment is as important as provision of water for agriculture, towns and industry	.700
	The quality and quantity of groundwater available to me is sufficient for all my needs	.365

Table 82 below reports provides an overview of the psychometric properties of the index and social indicators used in this study.

Table 82 Psychometric properties of scales and indicators used in this study

	Variance explained	Number of factors	Factor names	Factor names	Cronbach alpha
Deakin wellbeing Index	52%	1	Subjective wellbeing		.86
Work life balance	72%	2	Work life balance		.82
				Lack of leisure time (*single item*)	
Individual adaptive capacity	62%	1	Individual adaptive capacity		.84
Collective adaptive capacity	59%	2	Ability to work together		.70
				Community leadership	.70
Social capital	61%	2	Feeling safe in the community		.55
				Social support	.48
Biodiversity and water usage	70%	2	Support for biodiversity outcomes		.88
				Support for shared water usage (town, industry, environment)	.67

The established and validated scales for individual and collective adaptive capacity, and natural resource conditions outcomes demonstrated the strongest psychometric characteristics. We used these scales as indicators on the various attributes of interest in the communities. The exploratory factor analysis showed that the items accounted for approximately two-thirds or more of the variance, suggesting that a minimal amount of statistical noise was present in the resulting sub-scales, a conclusion supported by high scores each sub-scale recorded for internal reliability. Cronbach alphas for these items were in the high range from 0.78 to 0.88. The survey component of the study was primarily concerned with adaptive capacity and wellbeing in relationship to natural resource condition outcomes. As a team we considered that aspects of social capacity (particularly community connectivity), while implicit within notions of collective adaptive capacity, should also be considered with this study. However, taking into account Australian standards on survey length (see for example www.amsrs.com.au), we had to limit the number of survey items. However, given the results of this study, it will be possible for future studies to be more parsimonious in the questions asked of respondents while we able to more adequately examine the factors of interest.

The adaptive capacity and environmental indicators were all scored on a 1-5 scale. Summary sub-scales were in turn computer based on the mean of factor scores calculated for each item within the subscale. For ease of analysis and interpretation, the factor scores, which were calculated to four decimal places, were recoded back into the original scale as follows: (low thru 1.4999 =1) (1.5000 thru 2.4999 = 2) (2.5000 thru 3.49999 = 3) (3.5000 thru 4.4999=4) (4.5000 thru high = 5).

In addition to these indicators, an index of recent life stressors was created from the data. Respondents were asked to indicate (yes/no), whether or not they had experienced a number of recent life stressors

(natural disaster, explosion, assault, transport or work accident, life threatening illness, death of close relative or friend, marriage, birth or a child). A cumulative index of stressors (0-7) was summed by these responses and subsequently recoded into one of four groups, no life stressors, 1 or 2 life stressors respectively, and 3 or more life stressors.

Interpreting the indices and indicators

As a result of this data preparation, two indices (Deakin Wellbeing Index and cumulative life stressors) and seven indicators (addressing aspects of individual adaptive capacity, collective adaptive capacity, community connectivity and natural resource conditions) were produced and these indicators became the focus of reporting in this monograph.

To simplify reporting, the Deakin Wellbeing Index and the respective indicators were transformed in various ways. The Deakin Wellbeing Index is traditionally scored on a scale of 1- 10 where a score of one represents being completely dissatisfied with life and ten equates with being completely satisfied with life. Within this scoring system, a score of 7.5 represents the mean score and a score of less than 6 places a person in an at risk category. Notably scores below 60 were of concern with regards homeostatic failure (see Cummins 2009; Tanton et al 2012), with 6.2% of respondents reporting such a score.

Table 83 Summary scores for the index of subjective wellbeing

Deakin Wellbeing Index

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low	20	.0	.0	.0
	2.00	330	.4	.4	.4
	3.00	249	.3	.3	.7
	4.00	1128	1.3	1.3	2.0
	5.00	3548	4.1	4.1	6.2
	6.00	7785	9.1	9.1	15.3
	7.00	17264	20.2	20.2	35.4
	8.00	28973	33.9	33.9	69.3
	9.00	19488	22.8	22.8	92.1
	high	6795	7.9	7.9	100.0
	Total	85581	100.0	100.0	

In keeping with the protocol, the Deakin Wellbeing Index scores were multiplied by 10 in order to produce scores of between 0 and 100. Respondents reported a mean Index score of 7.79 (median 8.0; s.d. 1.29).

The items making up the indicator for individual adaptive capacity were originally scored where 1=Not at all true 2=Hardly true 3=Moderately true 4=Exactly true. These items were rescaled to a 1 – 5 scale by transforming the scores by multiplying the mean scale score by 1.25. The distribution of scores for the scale on individual adaptive capacity can be found in the table below. The indicator demonstrated a mean of 4.2 (median 4; s.d. 0.67). Scores of 3 and above would indicate that individuals concerned indicated that they had individual adaptive capacity at the time f completing the survey. It can be seen in the table below that the majority of respondents (87%) report a rating of 4 or above for individual adaptive capacity.

Table 84 Summary scores of the indicator - individual adaptive capacity

Indicator - individual adaptive capacity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low	108	.1	.1	.1
	2.00	1273	1.5	1.5	1.6
	3.00	9177	10.9	10.9	12.6
	4.00	46615	55.6	55.6	68.2
	high	26643	31.8	31.8	100.0
	Total	83816	100.0	100.0	

The distribution of scores for the index of cumulative stressors can be found in the table below. The index demonstrated a mean of 0.6 (median 0; s.d. 0.77). It can be seen in the table below that the majority of respondents (54%) report no significant life stressors in the past 12 months.

Table 85 Summary scores of the indicator - cumulative life stressors

Indicator - cumulative life stressors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	45480	54.3	54.3	54.3
	1	27634	33.0	33.0	87.2
	2	8652	10.3	10.3	97.6
	3 or more	2051	2.4	2.4	100.0
	Total	83816	100.0	100.0	

The distribution of scores for the indicator of collective adaptive capacity can be found in the table below. The indicators demonstrated a mean of 3.97 (median 4; s.d. 0.68). Scores over 3 and indicate that members of the community believed that they could work together to solve problems. It can be seen in the table below that the majority of respondents (80%) report values of 4 or 5 for collective adaptive capacity.

Table 86 Summary scores for the indicator – collective adaptive capacity (ability to work together)

Indicator - ability to work together

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low	245	.3	.3	.3
	2.00	2034	2.4	2.4	2.7
	3.00	14445	17.2	17.2	20.0
	4.00	51722	61.7	61.7	81.7
	high	15370	18.3	18.3	100.0
	Total	83816	100.0	100.0	

The distribution of scores for the indicator for community leadership can be found in Table 87. The distribution of scores on the indicator for community leadership, as identified from the factor analysis, was calculated from the collective adaptive capacity items. The scale demonstrated a mean of 3.3 (median 3; s.d. 1.07). Scores over 3 would suggest that the respondents considered that their area had

adequate (or better) community leadership. It can be seen in the table below that just under half the respondents (48%) provide positive ratings of their community leaders.

Table 87 Summary scores of the indicator community leadership

Indicator - community leadership scale

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low	4837	5.8	5.8	5.8
	2.00	13243	15.8	15.8	21.6
	3.00	25263	30.1	30.1	51.7
	4.00	32457	38.7	38.7	90.4
	high	8016	9.6	9.6	100.0
	Total	83816	100.0	100.0	

The distribution of scores for the indicator of community connectivity can be found in the table below. The indicator demonstrated a mean of 3.6 (median 4; s.d. 0.83). Scores over 3 suggest above average perception of connectivity within the community of interest. It can be seen in the table below that the majority of respondents (55%) report perceiving to be well connected to their community.

Table 88 Summary scores of the indicator – community connectivity

Scale of community connectivity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low	18	.8	.8	.8
	2.00	218	9.9	9.9	10.7
	3.00	750	34.2	34.2	44.9
	4.00	1005	45.8	45.8	90.7
	high	205	9.3	9.3	100.0
	Total	2196	100.0	100.0	

The distribution of scores for the indicator for social support can be found in the table below. The indicator demonstrated a mean of 3.8 (median 4; s.d. 0.91). Scores over 3 suggest above average levels of social support among members of the community of interest. It can be seen in the table below that the majority of respondents (64%) report above average ratings of social support.

Table 89 Summary scores of the indicator - social support

Scale of social support

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low	31	1.4	1.4	1.4
	2.00	139	6.3	6.3	7.7
	3.00	623	28.4	28.4	36.1
	4.00	917	41.8	41.8	77.9
	high	486	22.1	22.1	100.0
	Total	2196	100.0	100.0	

The distribution of scores for the indicator of perceptions of natural resource condition can be found in the table below. The indicator demonstrated a mean of 3.5 (median 4; s.d. 1.3). Scores over 3 would suggest that the respondents considered that their area had adequate (or better) biodiversity. It can be seen in the table below that the majority of respondents (67%) have a positive perceptions of the natural resource condition in their regions.

Table 90 Summary scores of the indicator - perceptions of natural resource condition

Indicator - natural resource condition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low	171	7.8	7.8	7.8
	2.00	194	8.8	8.9	16.7
	3.00	364	16.6	16.6	33.3
	4.00	738	33.6	33.7	67.1
	high	720	32.8	32.9	100.0
	Total	2187	99.6	100.0	
Missing	System	9	.4		
Total		2196	100.0		

The distribution of scores for the indicator for perceptions of natural resource condition across sectors can be found in the table below. The indicator demonstrated a mean of 4.3 (median 4; s.d. .83). Scores over 3 would suggest that the respondents supported water being shared across sectors. It can be seen in the table below that the majority of respondents (83%) are supportive of water sharing between industry, the community and the environment.

Table 91 Summary scores for the indicator – perceptions of importance of water for the environment

Indicator - shared water usage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low	41	1.9	1.9	1.9
	2.00	58	2.6	2.7	4.5
	3.00	267	12.2	12.2	16.7
	4.00	926	42.2	42.4	59.1
	high	894	40.7	40.9	100.0
	Total	2186	99.5	100.0	
Missing	System	10	.5		
Total		2196	100.0		

Approaches to understanding diversity within local communities

Just as every rural community is different, so too one can expect to find distinct differences within rural communities. A core component of this study is to develop insights into the potential relationship between adaptive capacity and wellbeing, taking into account the kinds and combinations of stressors which are unique to each community. One way to conduct such a study is through the use of factor-cluster analysis. Early in this chapter we outlined how the factors and subsequent sub-scales were developed for this study. In this section we outline how we approached the cluster analysis.

First and foremost, cluster analysis needs to be understood as a descriptive technique which is designed to reveal 'natural groupings within a collection of data ... data observations close together should fall into the same cluster while observations far apart should be in different cluster groups' (SPSS 1997: 2.1). The method for the cluster analysis undertaken in this study follows that outlined in the SPSS (1997) manual Market Segmentation Methods. Having developed the scales and sub-scales of interest the manual proposes the following steps:

- produced standardised z scores for responses to each item
- conduct a hierarchical cluster analysis and produce an agglomeration schedule of the coefficients of the scale items for each respondent
- plot these scores on a dot plot
- visually inspect the dot plot to hypothesise the number of clusters
- test the utility of this thesis using the K means clustering procedure.

These methods were followed for this study. For the purposes of this study, the six key social indicators of interest were used as the basis for the segmental analysis:

- individual adaptive capacity
- ability to work together
- community connectivity
- social support
- community leadership
- subjective wellbeing.

While conducting this analysis, a distinct segment was identified. This was one in which the people of the Namoi were over-represented in a segment which was characterised by feelings of not being safe. Notably, during the time the data was collected for this study, a police officer was shot dead in the Namoi town of Tamworth.[8] This is an unusual event to have occurred in a rural Australian community.

The data were reanalysed excluding the variable of 'feeling safe' and considered in the light of the key research question in this part of the study, the capacity to identify people who may have crossed a threshold or tipping point in wellbeing. Analyses which included and excluded the variable of 'feeling safe' both identified segments where a group of respondents may have a crossed a threshold in wellbeing. For the purposes of this analysis it was then decided to exclude the variable 'feeling safe'.

The Figure below presents the dot plot resulting from the production of the agglomeration schedule based on the six remaining variables of interest:

- individual adaptive capacity
- ability to work together
- community connectivity

[8] http://www.smh.com.au/nsw/heartfelt-sympathy-fatherofsix-police-officer-shot-and-killed-in-tamworth-20120302-1u73i.html

- social support
- community leadership
- subjective wellbeing.

It can be seen from this figure that there is one very distinct cluster along with another two or three clusters which are more similar in nature (SPSS 1997).

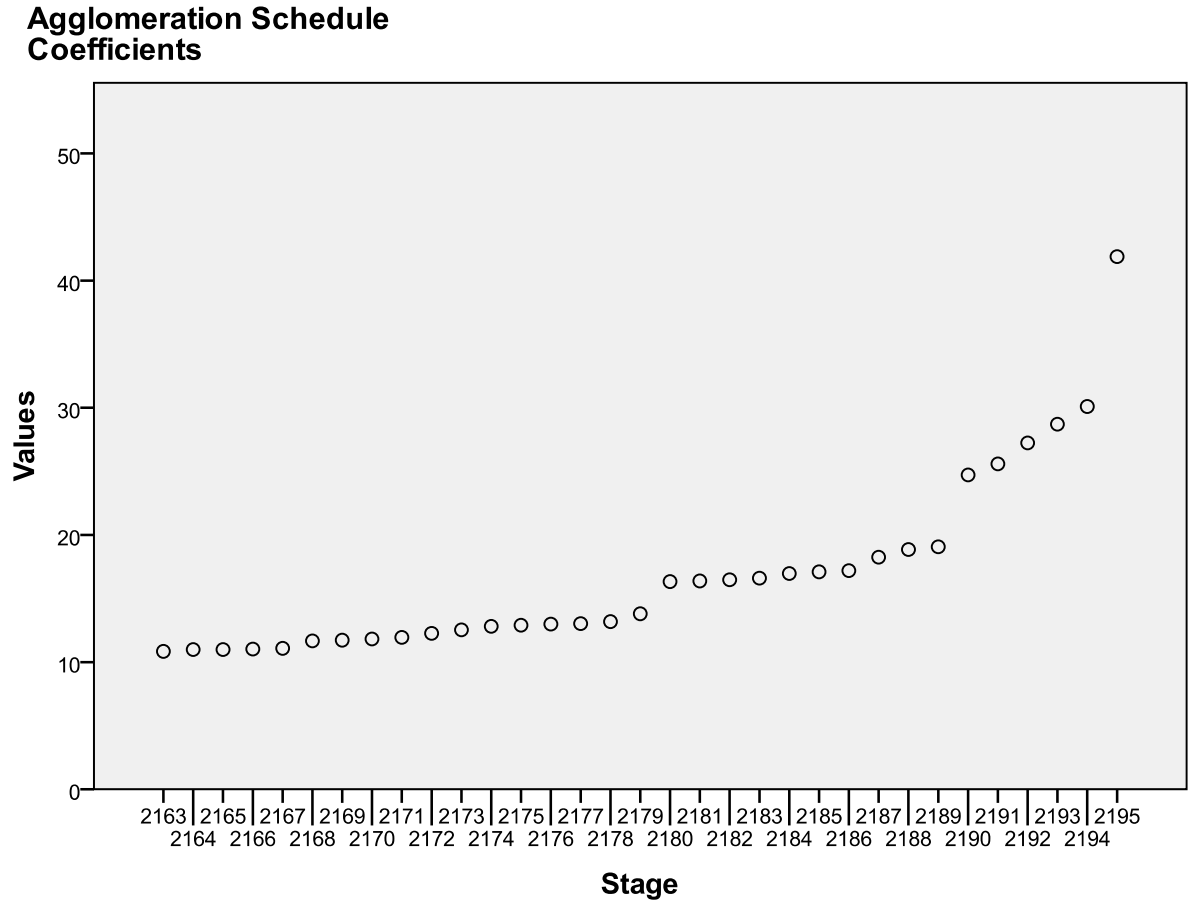


Figure 93 Visualising potential segments within the cluster analysis

In selecting the preferred solution to the question of clustering, one is particularly looking for a presentation of the data that provides the most useful or clearest insight into the research question of interest. The key question of interest in this study was the risk of people within communities, or the community itself, facing a critical tipping point in human subjective wellbeing, taking into account the dynamics of community leadership and individual adaptive capacity. After examining cluster solutions proposing 2, 3, and 4 groupings of the variables of interest, it was found that a 4 cluster solution uniquely presented distinct groupings between those facing a tipping point and those not along with groupings which profiled differences in community leadership and individual adaptive capacity.

The choice experiment

Choice modelling to identify factors that drive commitment to a community

Many actions in life involve people choosing between one action and another. People choose among competing options for things to do, for products to consume or even which social behaviours to exhibit that help explain who they are.

People also choose to stay or go in communities that are impacted by major shocks – be that economic, social, disaster, environmental or demographic. People can also choose to act now, later, or not at all. But how can we determine what people will do in various situations as communities change? While it is probably impossible to draw inferences about what one person would do it is possible to make predictions from the pattern of choices that groups of people might make.

By observing many peoples' trade-offs, you can infer the probability of a person deciding to stay or go as a community changes based on those aspects of a community that holds its members there and the socio-demographic characteristics of the person. Traditional research relies on the 'direct-question' method by asking human beings to rate or choose the aspects of a community that matter to them, from a list. However, this will generally yield no more information than the fact that human beings want all the benefits of their community and none of the downside that might come as the community is impacted by change.

To find the tipping point that causes people to leave a community, if executed as a traditional quantitative survey would tell us that people would prefer their community with all the benefits but not when they would give up on that community. It is hard for people to disentangle what motivates them to choose one thing over another (i.e. it is often hard to describe what drives choice). This results in overestimation of effects

Instead, a choice experiment requires that individuals be forced to make a trade-off between two or more options, sometimes also allowing 'None or Neither' as a valid response. This presentation of alternatives requires that some respondents decide whether their community with fewer benefits would still hold them. This information provides the key missing information necessary to understand the tipping points and if certain aspects of community are more important in keeping varies community segments in that community.

About choice modelling

Choice modelling is well established in fields of marketing, transport, tourism, environmental economics, health, consumer goods and financial products. It is based on well tested behavioural theories of consumer choice involving over 30 years of research. A Nobel Prize in economics went to Daniel McFadden for his contributions to choice modelling

Choice modelling is typically used when the need is to understand the dynamics of people's choice in a category. It relies on an integrated behavioural theory of decision-making, incorporating Lancastrian consumer thinking (from the field of psychology) and random utility theory (from economics). Essentially it says that people make choices as trade-offs between features inherent in a product or service or information bundle or in this case the community – there is a relative importance of attributes that is inferred in the choice. The choice model is concerned with the quantitative description of consumer preferences…how people trade off features when making choices…in our case under what conditions people would consider staying and under what conditions people wouldn't.

The approach used for the choice modelling exercise

The first stage involves defining the range of factors that are and could be at play in the decision making process based on the community visits and the social and economic modelling. This includes determining the potential options for each 'factor' (i.e. the minimum and maximum of each attribute's

level, and the measurement scale – whether it is continuous or discrete). They range over past, current and likely future values. The alternatives, factors and levels must be meaningful, clear and unambiguous to the people taking part in the choice model exercise. The following provides the different factors and levels used in the experimental design for this project.

Attributes	Level 1	Level 2	Level 3
1. Full time work	Levels of full time work are increased	Levels of full time work remains about the same	Levels of full time work are reduced
2. Part time work	Levels of part time work are increased	Levels of part time work remains about the same	Levels of part time work are reduced
3. Young people leaving	The proportion of young people and families remains the same	There is an increase in the number of young people leaving the community	Most young people leave the community and do not return.
4. The numbers of women (young and old)	The numbers of younger and older women remains the same	The numbers of younger women declines while the numbers of older women remains the same	There are fewer younger and older women in the community
5. Family and friends	Most family and friends remain in the community	Some family and friends have moved away	Most family and friends have moved away
6. Population change	Population remains as about the same (newcomers replace those who leave)	Population declines as few new people come	
7. Community and social life	Local sporting teams and local community groups continue as they are today	The local sporting teams can no longer continue	Local community groups can no longer continue
8. Education services	The local schools remain as they are	The high school closes and children have to be travel	The primary school closes and children have to travel
9. Health services	The current level of health services and doctors and /or nurses in the community remains the same	The local hospital closes	There is no local GP or community health service
10. Aged care	There is an increase in aged care services and facilities	The level of aged care services is maintained	There is a decline in the aged care services and facilities
11. Local businesses and employment	Some businesses and shops close but new and/or different businesses open	Some businesses, hotels (pubs) and the post office close but everything else is maintained	There are large numbers of closed shops and businesses
12. Tourism	Tourism increases	Tourism remains about the same	Tourism declines
13. Local Environment	The natural environment is improving	The natural environment is being maintained	The natural environment is being degraded

Figure 94 Factors used in the choice experiment

From the experimental design established in stage one we define a set of choice scenarios. The number of scenarios each respondent completes depends on the experimental design complexity (number attributes and levels) and sample size. In this particular project, participants in the choice model exercise saw eight separate choice scenarios.

Before reviewing the eight scenarios the following introduction was provided to the participants.

> "In this section of the research, we will show you some different scenarios for the way your community could be affected by changes such as a high value for the Australian dollar which might make exports less competitive (or reduce the volume of exports) or if water was limited due to drought.
>
> We will show you a bundle of different things that might happen in your community and we would like you to choose whether such a situation would cause you to think about leaving. Each 'Card' or bundle may look alike, but each is different. All you need to do, for each card, is decide which way you act. Show your choice by ticking one of the boxes at the bottom of the page. Base each decision on what you are shown on THAT page.
>
> Please do this for each card (or page) that you are shown.
>
> Treat each card (or page) as totally separate from the last.

You may see some terms used that you are not familiar with. To help you, we have provided a **Glossary** of definitions.

Please take a few minutes to read through the **Glossary** before starting the scenarios. Please **print out** this page so you can refer to them while you choose what you would do."

The glossary mentioned in the above introduction was as follows.

Community descriptions	Description
1. Full time work	Whether full time work opportunities are increasing, decreasing or staying the same
2. Part time work	Whether part time work opportunities are increasing, decreasing or staying the same
3. Number of young people	Whether there is a good level of young people present
4. The number of women	Whether there is enough women in the community (both young and old)
5. Family and friends	Whether family and friends are staying or leaving and whether the proportion leaving is increasing
6. Population change	Changes to the overall population of the community
7. Community and social life	Whether the clubs (sporting and community) are healthy and active, or not
8. Education services	The presence of local schools (primary and high school)
9. Health services	The presence of health services of various kinds
10. Aged care	The presence of aged care services
11. Local businesses and employment	The success of local business as seen by the opening or closing of shops etc
12. Tourism	Whether tourism to the community is increasing, decreasing or staying the same
13. Environment	Whether the environment is improving, being maintained or in decline. The evidence is things like more trees and groundcover for local habitat and improving biodiversity

Figure 95 Glossary of factors used in the choice experiment

Q: If you were faced with the following situation in your community would you remain or consider leaving?

Features	
Full time work	Levels of full time work are increased
Part time work	Levels of part time work are reduced
Young people leaving	There is an increase in the number of young people leaving the community
The numbers of women (young and old)	The numbers of younger and older women remains the same
Family and friends	Some family and friends have moved away
Population change	Population remains as about the same (newcomers replace those who leave)
Community and social life	The local sporting teams can no longer continue
Education services	The primary school closes and children have to travel
Health services	The current level of health services and doctors and/or nurses in the community remains the same
Aged care	There is a decline in the aged care services and facilities
Local businesses and employment	Some businesses, hotels (pubs) and the post office close but everything else is maintained
Tourism	Tourism remains about the same
Local Environment	The natural environment is being degraded

Which would you choose?	I'm likely to stay	I'm likely to go
	○	○

A. How likely are you to stay or go out of 100 where 100 means you would definitely stay/go and 0 means you won't.....?

I'm likely to stay _____ %
I'm likely to go _____ %

Please make sure that the total adds up to 100%.

B. Given the situation described above...

	Yes	No
Would your wellbeing be negatively affected by the situation described above?	○	○
Would you do anything differently?	○	○

C. What would you be doing differently?

If you said YES for 'Would you do anything differently?' in above please answer this question....

_____

_____

_____

By varying the alternatives presented to each respondent and evaluating their choices, we are able to quantify the value (utility) of each factor and measure the impact of each on the community.

Once data is collected, coded and cleaned, model estimation can commence. A choice based demand model is then developed to simulate consumers' behaviour and provide support to management decisions. We use Hierarchical Bayesian mathematics which provides heightened sensitivity in

modelling (i.e. any differences are more evident between segments making it more accurate) and the opportunity to filter analysis by many variables.

The principal deliverable of the choice modelling exercise is the decision support or 'what if' tool, with which the community and decision makers can test endless combinations of possible real world market scenarios before they actually happen. The decision support tool has been developed with custom built software.

This provides the community and decision makers with an easy way to examine:

- how a change in the level of any given factor or combination of factors will affect people staying or leaving and their sense of wellbeing and what they may do differently
- acceptance or otherwise of scenarios, the impact on well-being and the tipping points for community sustainability – i.e. what will happen to the community
- the optimal settings to avoid and unviable community.

Appendix C Copy of survey instrument

Sustainable Communities

Introduction

Across the community there are wide spread concerns about changes in the state of natural resources (e.g. availability of irrigated water; clearing of native vegetation) and the wellbeing of local people. To this end the Cotton Communities CRC, Rural Industries Research & Development Corporation and the Namoi CMA have commissioned this study which looks at the wellbeing of communities which face the challenge to adapt to changes arising from factors such as global economics, drought and climate variability, the Basin Plan and coal seam mining. I invite you to participate in this study. The results of survey will be used to get a better understanding of how communities are adapting to change. Would you be interested in participating in this study?

NO – THANK AND CLOSE.

YES – Great. I now just need to ask you a few short questions to see if you are eligible to participate.

Survey instrument used in this study

SCREENERS– just to ensure that we have a representative sample

X1. LOCALITY – retain in data set from dataset used for dialing respondent. For Namoi respondents

[INTERVIEWER TO RECORD FROM LIST]

❍ Tamworth incl Walcha (Namoi Region) (1)
❍ Gunnedah Warrumbungles (Namoi Region) (2)
❍ Liverpool Plains (Namoi Region) (3)
❍ Narrabri (Namoi Region) (4)
❍ Walgett (Namoi Region) (5)
❍ St George (6)
❍ Waikerie (7)

X2. Do you live within a regional town, or village, or is your residence located outside of the town boundary?

❍ Within town or village (1)
❍ Outside of town or village (2)

[ASK ALL]

X3. Are you a primary producer/farmer?

❍ Yes, primary producer/farmer (1)
❍ No, not primary producer/farmer (2)

[IF PRIMARY PRODUCER]

X4. What type of farmer are you? Just say yes or no as I read out the list.

❍ Beef and cattle (1)
❍ Wheat, barley or any form of grain or legume farmer (2)
❍ Sheep farmer (3)
❍ Wool farmer (4)
❍ Forestry (5)
❍ Fishery (6)
❍ Horticulture (7)
❍ Dairy (8)
❍ Poultry and piggeries (9)
❍ Viticulture (10)
❍ Other (Specify) (11)

[IF OUTSIDE OF TOWN OR PRIMARY PRODUCER]

X5. About how large is your land holding?

❍ Under 5 Hectares (1) [HOBBY FARMER]
❍ 5-25 Hectares(2)
❍ 25-100 Hectares (3)
❍ 100+ Hectares (4)
❍ [DNRO] Don't know/Refused (5)

[IF OUTSIDE OF TOWN OR PRIMARY PRODUCER]

X6. Is your primary source of income derived from your land holding, or is it derived through other means?

❍ Through use of the land holding, farming [PRIMARY PRODUCER]
❍ Through other means, farming is not primary income source [HOBBY FARMER]

[IF NOT PRIMARY PRODUCER]

X7. In your line of work, do you provide services to primary producers and land managers, such as contracting, consulting, sale of goods, or provide advice on land management?

❍ Yes (specify)
❍ No

SCREEN BY AGE– retain response in the data set and code as follows:

X8. Which of the following age categories do you fit into?

❍ 18 - 24 years (1)
❍ 25 - 34 years (2)
❍ 35 - 44 years (3)
❍ 45 – 54 years (4)
❍ 55 – 64 years (5)
❍ 65 – 74 years (6)
[IF <18, or 75+ TERMINATE]

SCREEN BY SEX– retain response in the data set and code

X9. Gender [INTERVIEW TO RECORD, NOT ASK]

❍ Male (1)
❍ Female (2)

END OF SCREENERS

Module A: Health and Wellbeing

The first part of our survey is concerned about your general wellbeing and how satisfied you are with different aspects of your life. I am going to read to you a series of statements about wellbeing. I would like you give a rating for each statement using a scale from 1 to 10 where 1 is completely dissatisfied and 10 is completely satisfied.

A1a. Thinking about your own life and your personal circumstances, how satisfied are you with your life as a whole?

	1 Completely Dissatisfied (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	8 (8)	9 (9)	10 Completely Satisfied (10)
(1)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

A1b. Turning now to various areas of your life….

	1 Completely Dissatisfied (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	8 (8)	9 (9)	10 Completely Satisfied (10)
How satisfied are you with your standard of living? (1)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
… with your health? (2)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
… with what you are currently achieving in life? (3)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
… with your personal relationships? (4)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
… with how safe you feel? (5)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
… with feeling part of your community? (6)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
… with your future security? (7)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

A2. In general, would you say your health is?

❍ Excellent (5)
❍ Very good (4)
❍ Good (3)

❍ Fair (2)
❍ Poor (1)

A3. I am now going to read to you a list of difficult or stressful things that sometimes happen to people. For each event, please tell me (yes/no) whether or not you have experienced this event in the last 12 months:

1. Experienced a natural disaster (PROMPT IF NEEDED: for example, flood, drought, tornado, earthquake)

2. Were in a fire or explosion

3. Were in a transportation accident (for example, car accident, boat accident, train wreck, plane crash)

4. Had a serious accident at work, home, or during recreational activity

5. Were assaulted (PROMPT IF NEEDED: for example, being attacked, hit, slapped, kicked, beaten up, sexual assault)

6. Experienced a life-threatening illness or injury

7. Someone close to you died

8. You got married

9. A child was born into your family

Module B: Self Efficacy

B1. I am now going to read to you a series of statements which are concerned with individual approaches to problem solving. Please rate each one on a scale of one to four where 1=Not at all true 2=Hardly true 3=Moderately true 4=Exactly true.

	Not at all true (1)	Hardly true (2)	Moderately true (3)	Exactly true (4)
I can always manage to solve difficult problems if I try hard enough (1)	❍	❍	❍	❍
If someone opposes me, I can find the means and ways to get what I want (2)	❍	❍	❍	❍
I am certain that I can accomplish my goals (3)	❍	❍	❍	❍
I am confident that I could deal efficiently with unexpected events (4)	❍	❍	❍	❍
Thanks to my resourcefulness, I can handle unforeseen situations (5)	❍	❍	❍	❍
I can solve most problems if I invest the necessary effort (6)	❍	❍	❍	❍
I can remain calm when facing difficulties because I can rely on my coping abilities (7)	❍	❍	❍	❍
When I am confronted with a problem, I can find several solutions (8)	❍	❍	❍	❍
If I am in trouble, I can think of a good solution (9)	❍	❍	❍	❍
I can handle whatever comes my way (10)	❍	❍	❍	❍

Module C: Community Efficacy

C1. Would you please indicate whether or not you are a member of any of the following groups or organizations (ACCEPT MULTIPLE RESPONSES)

Please choose all that apply

- ❑ Service Club (e.g. Rotary, Quota, Lions) (1)
- ❑ CWA Board member or employee (2)
- ❑ Religious or Church groups (3)
- ❑ Play group for children (4)
- ❑ Member of a specific cultural or migrant group (prompt to specify) (5)
- ❑ Country Fire Association (6)
- ❑ Farm industry group (e.g. NFF, Elders) (7)
- ❑ Sports club (e.g. Bowling/Football/Golf) (8)
- ❑ Specific environmental groups (e.g Landcare, WWF) (9)
- ❑ Men's Sheds (10)
- ❑ Community arts, drama or music group (11)
- ❑ Others (please write here which group you are a member of): (12)_____
- ❍ None of the above (6)

C3. The next set of questions is concerned with your general feelings about living in your local community, please indicate the extent to which you agree or disagree with each of the following statements where 1 = strongly disagree and 5 = strongly agree:

	Strongly Agree (5)	Agree (4)	Neither Agree nor Disagree (3)	Disagree (2)	Strongly Disagree (1)
We can greatly improve services in the community even when not everyone agrees (1)	❍	❍	❍	❍	❍
We can improve the quality of life in the community, even when resources are scarce (2)	❍	❍	❍	❍	❍
Our community can co-operate in the face of difficulties to improve the quality of community facilities (3)	❍	❍	❍	❍	❍
The community can present a united vision to outsiders (4)	❍	❍	❍	❍	❍
The people in this community can work together even when it requires more effort than normal (5)	❍	❍	❍	❍	❍
We can resolve crises in this community without any negative after effects (6)	❍	❍	❍	❍	❍
Our community can improve services for citizens without help from the council or other government agencies (7)	❍	❍	❍	❍	❍
The members of this community talk about issues they are interested in (8)	❍	❍	❍	❍	❍
How this community thinks about problems determines what we do about them (9)	❍	❍	❍	❍	❍
Our community has a strong leader who would lead us through significant changes e.g. climate variability and drought; global economics and industry change etc (10)	❍	❍	❍	❍	❍
Our local council is very effective in planning for our community (11)	❍	❍	❍	❍	❍

C3b. With regard to your general feelings about living in this community, please indicate the extent to which you agree or disagree with each of the following statements:

	Strongly Agree (5)	Agree (4)	Neither Agree nor Disagree (3)	Disagree (2)	Strongly Disagree (1)
Our community has all the professional expertise (eg, Doctors, Teachers, Mechanics, etc) that we need (1)	❍	❍	❍	❍	❍
ASK ONLY THIS QUESTION IF ANSWER TO C3b 1 = 4 0R 5 These professionals have good experience in their fields (2)	❍	❍	❍	❍	❍
Climate change poses a risk to our community (3)	❍	❍	❍	❍	❍
Water allocation should change so enough water is available for the natural environment (4)	❍	❍	❍	❍	❍
Responsibility for water reform rests with the whole community (5)	❍	❍	❍	❍	❍
The farmers I know care for the environment (6)	❍	❍	❍	❍	❍
A vibrant agricultural industry is a core part of the nation's identity (7)	❍	❍	❍	❍	❍
Australian Government policies (e.g., research & development, carbon, water, drought relief) are addressing the business needs of rural and regional Australia (8)	❍	❍	❍	❍	❍
State Government policies such as health services, education, social welfare are addressing the support needs of people living in rural and regional Australia (9)	❍	❍	❍	❍	❍
Country people are having a fair say in the development of rural and regional policy in Australia (10)	❍	❍	❍	❍	❍
Australian Government business (research & development, carbon, water, drought relief) and social policy (health services, education, social welfare) are giving country people a fair go (11)	❍	❍	❍	❍	❍

C4. I am now going to read to you some statements concerned about the extent to which you consider that you are or could be easily be involved in the local decision-making process. Please indicate the extent to which you agree or disagree with each of the following statements:

	Strongly Agree (5)	Agree (4)	Neither Agree nor Disagree (3)	Disagree (2)	Strongly Disagree (1)
The big decisions in this area are mostly made by the Council. (1)	❍	❍	❍	❍	❍
There are a broad variety of groups involved in decision making in this area. (2)	❍	❍	❍	❍	❍
Anyone can easily participate in decision making in this area if they want to. (3)	❍	❍	❍	❍	❍

C5. With regard to your general feelings about Wellbeing and Community Connectedness, please indicate the extent to which you agree or disagree with each of the following statements:

	Strongly Agree (5)	Agree (4)	Neither Agree nor Disagree (3)	Disagree (2)	Strongly Disagree (1)
Most people in this community can be trusted (1)	❍	❍	❍	❍	❍
I feel safe walking down my street after dark (2)	❍	❍	❍	❍	❍
I always feel I am an important part of this community (3)	❍	❍	❍	❍	❍
I have opportunities to participate in affordable local arts and cultural activities if I want to (4)	❍	❍	❍	❍	❍
This community accepts people from different cultures and backgrounds (5)	❍	❍	❍	❍	❍
If I could not drive, I would be able to get to the nearest major regional centre using other means e.g. public transport, friends and family members etc. (6)	❍	❍	❍	❍	❍
I am able to get help from family and friends when needed. (7)	❍	❍	❍	❍	❍

C6b. How much time would you spend in working for voluntary organisations each week?

❍ 1 – 4 Hours (1)
❍ 5 – 9 Hours (2)
❍ 10 – 19 Hours (3)
❍ > 20 Hours (4)
❍ No Time (5)

C7. With regard to the future security of your community, please indicate the extent to which you agree or disagree with each of the following statements:

	Strongly Agree (5)	Agree (4)	Neither Agree nor Disagree (3)	Disagree (2)	Strongly Disagree (1)
This community has a strong and viable future ahead (1)	❍	❍	❍	❍	❍
If something happens to my present job, I would be able to find another job in this area comfortably (2)	❍	❍	❍	❍	❍
The impact of wind farms, water rights, climate variability, genetically modified crops etc. could potentially lead to a large number of people leaving this community (3)	❍	❍	❍	❍	❍

C7b. If any of the following services closed, would you think about leaving this area? ACCEPT A RESPONSE OF NOT APPLICABLE

	I would definitely leave (5)	I would most probably leave (4)	I don't know if I would leave or not (3)	I most probably would not leave (2)	I would definitely NOT leave (1)	Not Applicable - There is no/no longer a facility nearby (6)
1. Public Hospital (1)	❍	❍	❍	❍	❍	❍
2. School (2)	❍	❍	❍	❍	❍	❍
3. Pub (3)	❍	❍	❍	❍	❍	❍
4. Bank (4)	❍	❍	❍	❍	❍	❍
5. Rural Fire Brigade (5)	❍	❍	❍	❍	❍	❍
6. Community Welfare Association (6)	❍	❍	❍	❍	❍	❍
7. Club (7)	❍	❍	❍	❍	❍	❍

WHERE RESPONDENT ANSWERED 1,2 OR 3 TO ITEMS IN QC7 ABOVE ASK THE FOLLOWING.

You said that the closure of (x,y, or z services) would not result in you definitely leaving this community. Would this decision change and several of these services closed one after the other?

Yes (1) No (2)

If yes, for you which combination of services closing would mean that you would decide to leave this community (**OPEN ENDED**)

C8. In terms of your spiritual beliefs would you define yourself as...

❍ Very Spiritual (5)
❍ Spiritual (4)
❍ Fairly Spiritual (3)
❍ Not very Spiritual (2)
❍ Not Spiritual at all (1)

[ASK CODE 3 OR 4 OR 5 IN C8]

C8b. With regard to your spiritual beliefs, please indicate the extent to which you agree or disagree with each of the following statements:

	Strongly Agree (5)	Agree (4)	Neither Agree nor Disagree (3)	Disagree (2)	Strongly Disagree (1)
My religious or spiritual tradition provides me with comforting beliefs (especially in times of suffering or death). (1)	❍	❍	❍	❍	❍
My religious or spiritual tradition provides me with a strong network of social support (2)	❍	❍	❍	❍	❍

Questions on the environment (rated on a likert scale (strongly disagree-strongly agree of 1-7) Allow a response for don't know

C9. The following statements are concerned with environmental issues in the area in which you live. On a scale of 1 - 7 where 1 means you strongly disagree with the statement and 7 means that you strongly agree with the statement) the extent to which you either agree or disagree with the statements.

	1 Strongly Disagree (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 Strongly Agree (7)	Don't Know (99)
There are enough trees in the regional landscape to provide sufficient food and shelter for native plants and animals	❍	❍	❍	❍	❍	❍	❍	❍
There are enough shrubs and grasslands in the region to support native birds, animals and plants	❍	❍	❍	❍	❍	❍	❍	❍
Sufficient resources have been allocated to protect endangered plant and animal species in this area	❍	❍	❍	❍	❍	❍	❍	❍
Our community has been successful in preventing new pests animals and weeds from getting established in our area								
There is enough groundcover in our area to prevent damage such as erosion or dust storms	❍	❍	❍	❍	❍	❍	❍	❍
There are too many areas in our region which do not have enough groundcover	❍	❍	❍	❍	❍	❍	❍	❍
There is enough water in our area to adequately support the environment as well support agriculture, towns and industry.	❍	❍	❍	❍	❍	❍	❍	❍
Our rivers and creeks are in good condition with stable banks and healthy riverside vegetation.	❍	❍	❍	❍	❍	❍	❍	❍
Provision of water for the environment is equally as important as provision of water for agriculture, towns and industry.	❍	❍	❍	❍	❍	❍	❍	❍
It is important to protect and manage the remaining wetlands in the region.	❍	❍	❍	❍	❍	❍	❍	❍
The quality and quantity of groundwater available to me is sufficient for all my needs	❍	❍	❍	❍	❍	❍	❍	❍
Our community and industry rely on access to groundwater	❍	❍	❍	❍	❍	❍	❍	❍

C.10A – Weather events

Over the past decade various parts of regional and rural Australia have been affected by drought and/or floods. On a scale of 1 - 7 where 1 means you strongly disagree with the statement and 7 means that you strongly agree with the statement), to what extent would you either agree or disagree that your financial wellbeing has been adversely affected by:

Drought (e.g. 2000 - 2010)

	1 Strongly Disagree (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 Strongly Agree (7)	Don't Know (99)
Drought (e.g. 2000 – 2010)	❍	❍	❍	❍	❍	❍	❍	❍
Flooding (e.g. 2011, 2012)	❍	❍	❍	❍	❍	❍	❍	❍

C.10b And to what extent would you either agree or disagree that your emotional wellbeing has been adversely affected by:

	1 Strongly Disagree (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 Strongly Agree (7)	Don't Know (99)
Drought (e.g. 2000 – 2010)	❍	❍	❍	❍	❍	❍	❍	❍
Flooding (e.g. 2011, 2012)	❍	❍	❍	❍	❍	❍	❍	❍

Module D: Employment, Financial Hardship and Work-life balance

In conducting our research, we need to take into account peoples' employment and financial situation. Without this data, we cannot get a true picture of the challenges people face.

S1. In order for us to be able to analyse our results at a local level, can you please record tell me the post code where you live:

☐

S2. And approximately how long have you lived at this address _____ (**YEARS**)

S3 What year did you move to this community?"

"I have always lived here",

and a data entry box to type in a specific year ☐☐☐☐

Economic questions

[ASK ALL]

QE1 How do you feel about your ability to continue to earn an income in your local town?

- Very positive
- positive
- neither positive nor negative
- negative
- very negative

[ASK ALL]

QE2. What would you do if you lost your job?

- Go on the dole
- Retire
- Leave town to get a job
- Get another job locally
- Rely on your partners job
- Sell assets to enable you to live
- Sell business (if business owner)
- Change business (if business owner)
- Start new business (if either business owner or employed)
- Other Pls specify

[ASK ALL]

QE3. How confident are you that you could find income this way?

- Very confident
- confident
- neutral
- unconfident
- very unconfident

D1. Which of these best describes your current employment situation?

❍ Self employed (1)
❍ Employed for wages, salary or payment in kind (2)
❍ Unemployed and looking for work (3)
❍ Engaged in home duties (4)
❍ Full time student (5)
❍ Retired (6)
❍ Unable to work (not due to age) (7)
❍ Other (please write here): (8)_____

[ASK CODE 1 OR 2 IN D1]

D1b. Which of these best describes your current type of work?

❍ Full time (1)
❍ Part time (2)
❍ Causal (3)
❍ Contract (4)
❍ Other (5)_____

[ASK CODE 1 OR 2 IN D1]

D1c. Which are of industry or business are you working in? **ACCEPT OPEN ENDED REPONSE AND CODE TO THE FOLLOWING GROUPS**

❍ Accommodation and Food Services (1)
❍ Administrative and Support Services (2)
❍ Agriculture, Forestry and Fishing (3)
❍ Arts and Recreation Services (4)
❍ Construction (5)
❍ Education and Training (6)
❍ Electricity, Gas, Water and Waste Services (7)
❍ Financial and Insurance Services (8)
❍ Health Care and Social Assistance (9)
❍ Information Media and Telecommunications (10)
❍ Manufacturing (11)
❍ Mining (12)
❍ Professional, Scientific and Technical Services (13)
❍ Public Administration and Safety (14)
❍ Rental, Hiring and Real Estate Services (15)
❍ Retail Trade (16)
❍ Transport, Postal and Warehousing (17)
❍ Wholesale Trade (18)
❍ Other, please specify (19)_____

[ASK CODE 1 OR 2 IN D1]

D2. I am now going to read a a series of statements to you about your experience at work. Please read each one and rate them on a scale of one to seven where 1 means you strongly disagree with the statement and 7 means you strongly agree with the statement.

	1 Strongly Disagree (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 Strongly Agree (7)
My work is too demanding and stressful (1)	❍	❍	❍	❍	❍	❍	❍
I spend too much time and energy on work (2)	❍	❍	❍	❍	❍	❍	❍
My work and family life often interfere with each other (3)	❍	❍	❍	❍	❍	❍	❍
I have good job security (4)	❍	❍	❍	❍	❍	❍	❍
I am satisfied with the amount of leisure that I enjoy (5)	❍	❍	❍	❍	❍	❍	❍

D7. What is the highest level of education you have completed?

❍ Never attended school (1)
❍ Some primary school (2)
❍ Completed primary school (3)

❍ Some high school (4)
❍ Completed high school (i.e. Year 12, Form 6, HSC) (5)
❍ TAFE or Trade Certificate or Diploma (6)
❍ University, CAE or some other Tertiary Institute degree, including post university (i.e. postgraduate diploma, Master's degree, PhD) (7)
❍ Other (8)_____

D8. Which of these best describes your household?

❍ Single under 30 years (1)
❍ Single 30 years and over (2)
❍ Share accommodation (3)
❍ Couple without children (4)
❍ Family with most children under 16 years (5)
❍ Family with most children 16 years or older (6)
❍ Other, please specify (8)_____

D9. What type of internet connection do you have at your home?

❍ Broadband (incl. ADSL, Cable, Wireless and Satellite connections) (1)
❍ Dial up (incl. analogue modem and ISDN connections) (2)
❍ No internet connection (3)

D11. And finally, We would now like to ask you about your household's income. We are interested in how income relates to health and well being. Before tax is taken out, which of the following ranges best describes your household's approximate income, from all sources, over the last 12 months?

❍ Less than $10,000 (1)
❍ $10,000 – less than $20,000 (2)
❍ $20,000 – less than $40,000 (3)
❍ $40,000 – less than $60,000 (4)
❍ $60,000 – less than $80,000 (5)
❍ $80,000 – less than $100,000 (6)
❍ $100,000 – less than $120,000 (7)
❍ $120,000 and over (8)
❍ Refused (9)

Request permission to undertake the choice model survey:

D12. We have another, very important part of the study. We have devised 8 potential scenarios that could happen to your town. We want to know what you would do if they ever came true. This will take a few minutes to do but we need to send you the scenarios. They are too complicated to explain but easy when in front of you.

Could we email this to you?

❍ Yes (1)
❍ N0 (2)

[If YES ASK]

Can I have your email please? _____

I'll repeat that back to you? [REPEAT then ASK]: Is that correct?

❍ Yes (1)
❍ N0 (2) If NO ASK THEM TO SPELL OUT THE EMAIL AGAIN.

IF NO In D12 or when the email address has been provided - SAY

And that's the end of our questions. Thank you very much for completing our survey. If you have any questions about this survey you can speak Dr Anthony Hogan on 02 6125 2909 or Assoc Professor Robert Tanton on 02 6201 2769. Concerns or complaints you have about how the study is being conducted can be directed to - Executive Officer, Human Research Ethics. Please do not hesitate to be in touch with me on 6125 2909 (anthony.hogan@anu.edu.au) if you would like to discuss this study with me. This study is being conducted with the approval of the Human Ethics Committee at the ANU. Should you have any ethical concerns about the study which I cannot resolve for you, you can be in touch with the Committee Human Ethics Officer at The Australian National University on (02) 6125 3417 (human.ethics.officer@anu.edu.au).

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The Community Adaptability Tool

By Anthony Hogan, Dean Carson, Jen Cleary, David Donnelly and Kim Houghton,

Edited by Rebecca Philips and Robert Tanton

Pub. No. 14/041

This project developed a methodology, the Community Adaptability Tool (CAT), for enabling communities to assess their socio-economic sustainability in the face of many change processes.

This report describes 'concept testing' of the specific discipline-based (economics, demography, community development, sociology and social research) components of the CAT, as well as testing of the extent to which they could produce useful socio-economic indicators which communities could use to inform their decision making.

Examples have been included of the information collected in three case study sites -Waikerie, St George and Gunnedah.

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