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Preface

The 37th Annual Conference of the Australian and New Zealand Regional Science Association International (ANZRSAI) was held on the Fraser Coast campus of the University of Southern Queensland from 4th to 7th December, 2013. A broad range of papers from academics, policy advisors and practitioners was presented to the conference. This publication contains the refereed proceedings of those contributed papers.

Participants who submitted their full paper by the due date were eligible to be considered for these refereed proceedings. There were 12 papers submitted to a double blind refereeing process, all of which were accepted for presentation in this publication. As in previous conferences, I am very grateful to referees for their work within a short timeframe.

Three awards were presented at the conference dinner. The John Dickinson Memorial Award for best article in the *Australasian Journal of Regional Science* 2013 was awarded to Fang Huang (Murdoch University, Perth) and John Rice (Griffith University, Gold Coast,) for their article "Does Open Innovation Work Better in Regional Clusters?" published in volume 19(1), pp. 85-120.

The ANZRSAI Award for Best Conference Paper 2013 was awarded to Maheshwar Rao, Robert Tanton and Yogi Vidyattama for their paper "An Integrated Approach to Analyse the Impacts of Water Policy Reform in the Murray-Darling Basin: A Conceptual Modelling Framework". This paper is the first paper presented in these proceedings.

The ANZRSAI Award for Best Conference Paper by a Current or Recent Student 2013 was awarded to Tasmiha Tarafder for her co-authored paper "Reproductive Health Beliefs and Perceptions among Slum Women in Bangladesh: Is this a Challenge to MDG5 Health Goal?". The committee highly commended one other entrant for this Award: Christina Kargillis for her paper "Small Town Pioneers: Renegotiating Self in Seachange Workers". Both of these papers are also presented in these proceedings.

I thank all the participants for their involvement in our 37th Annual Conference, particularly those who had travelled some distance from overseas to attend. The international community of regional science scholars is strengthened when people gather to share their research and expertise at conferences such as this.

Professor Paul Dalziel
Editor, 37th Annual ANZRSAI Conference Proceedings

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An Integrated Approach to Analyse the Impacts of Water Policy Reform in the Murray-Darling Basin: A Conceptual Modelling Framework

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ABSTRACT

The water policy reform in the Murray-Darling Basin (MDB) will have a range of implications on the socio-ecological system (SES) of the Basin. We propose an analytical framework that may be useful in analysing how policy changes or external shocks, which originate in one part of a SES can be traced transparently throughout the SES by sequentially linking a series of models, where each model has demonstrated strength in explaining a part of the whole system. This framework is suitable to analyse the national, regional and spatial socio-economic and distributional effects of regional-specific policy reforms or external shocks.

INTRODUCTION: WATER POLICY REFORM UNDER THE MURRAY DARLING BASIN PLAN

The Murray-Darling Basin (MDB) is an important regional economy for Australia in terms of its economic, social and environmental significance.[1] It can be treated as a socio-ecological system (SES) encompassing the ecology, the economy and the community or the social system, all of which are intricately interdependent and interconnected. The Basin's irrigated agricultural economy is largely dependent on water from the Basin's river network. The community, in turn is largely dependent on the agricultural economy of the Basin.

At least in the last two decades, the sustainability of the Basin's ecosystem (due combined impacts of severe drought and water over-allocation to irrigation) have brought to the forefront, the public policy debate on the competing demands for water for the environment/ecology and the economy. These are the requirement for environmental flows for the long-term health of the river system in the Murray-Darling Basin (MDB) on the one hand and the sustainability of irrigated agricultural production in the Basin on the other. For example, as early as mid-1992, the then Murray-Darling Basin Ministerial Council initiated the development of an irrigation management strategy with the aim "to achieve an ecologically and environmentally sustainable and self-sufficient irrigation system in the SMDB by 2010" (Hall, *et al*, 1994, p. iv; SMDB is the Southern Murray-Darling Basin). This water management strategy, articulated two decades ago, remains the overall aim of the Basin

[1] For more details of the social, economic and ecological significance of the MDB, see Rao *et al*. (2013).

Plan (discussed below), which is now under the responsibility of the Murray-Darling Basin Authority (MDBA).

The water policy reform under the Murray-Darling Basin (MDB) Plan[2] aims to achieve two broad objectives: first, to improve and restore the health of the river system in the Basin and second, to encourage farmers to adapt to reduced inputs of water for farming activities. The implementation of the MDB Plan falls under the responsibility of the Murray-Darling Basin Authority (MDBA) specifically created under the Australian Water Act (2007) to manage the water resources in the Basin. The core of the Basin Plan is the attainment of Sustainable Diversion Limits (SDLs), that is, limiting the amount of water that can be diverted to irrigation. SDLs are upper limits on the volume of water that can be taken on a sustainable basis from the Basin's river system. Under the Basin Plan, the SDLs can be achieved in two ways. First, through the Commonwealth buying back permanent water rights from farmers under the water buyback scheme and second, through water-saving infrastructural investment under the infrastructure investment scheme. Under the water buyback scheme, the Commonwealth buys back water entitlements (permanent water rights) from farmers who are willing to sell them on a voluntary basis. This reduces water available for irrigation, thus contributing to an overall SDL target.

Farms are commercial enterprises, and are likely to respond to the reduced inputs of water (and the consequent increase in its price) by, for instance, switching some irrigation activities to dry-land activities, substituting between factors of production, investing in water-saving infrastructure and technology, and so forth (Dixon *et al*, 2012a). To assist the farmers adapt to the new economic conditions, the second component of the Basin Plan involves the Commonwealth and States investing in water-saving infrastructure aimed at increasing the efficiency in water use and technological improvements in farming activities, that is, adopting technologies (input-mix) that minimises water usage per unit of output. One of the important developments achieved in the mid-90s, which may assist farmers in the Basin to adapt more quickly to reduced water availability, is the disentangling of water rights from land rights. Assigning and legally recognising property rights to water facilitated the creation of water markets, thus giving farmers the possibility of trading water intra- and inter-regionally, and since 1998 water trading has been possible between States. Assigning property rights to water also made it possible to permanently buy or sell water entitlements/rights. Australian evidence shows that water markets help reallocating water to more productive uses (Turral *et al*, 2005). In addition, the possibility of trading water provides farmers an additional option when determining the optimal allocation of resources in adapting to reduced inputs of water (Dixon *et al*, 2012a). For more details of the role and development of water markets in the MDB see Crase *et al*. (2004) and Qureshi *et al*. (2009).

In addition, the Basin Plan has further implications. Underlying the health of the MDB river system is the sustainability of the Basin's ecosystem, and thus, the current and future supply of ecosystem services, including the future flow of water for irrigation and other consumptive uses. Similarly, underlying the sustainability of agricultural production in the MDB is the livelihood and well-being of the Basin communities. In this regard, for analytical purposes, the MDB region can be conceptualised as comprising of three broad systems: the economic, the ecological and the social systems. These systems are evidently interdependent and linked in complex ways. In other words, for analytical purposes, the MDB can be treated as a SES. A perturbation in one system, say caused via an external shock or a policy change, can directly and/or indirectly affect other two systems. These effects can be transmitted throughout the SES through various channels and in complex ways via feedback loops. In this regard, given

[2] A brief background to the development of the Basin Plan is given in Crase (2012).

the interdependent and interconnectedness of a SES, it can be difficult for any single model to adequately capture the complexity of integrated systems such as a SES. In this paper, we propose a conceptual and analytical framework, which may be useful in analysing how policy changes and external shocks (such as climatic events) that originate in one part of a SES can be transparently traced throughout the SES. This can be achieved by linking a series of models, each model informing other models, thus drawing on the strengths of each model designed to explain a part of the whole system.

It is worth noting that models are simplifications but provide useful frameworks to make sense of the real world. Evidence shows that simple models outperform analyses or prediction based on no models at all, that is on expert opinions (Tetlock, 2005). Moreover, people who use a number of integrated models are likely to be better predictors than those using one large single model. For instance, Tetlock (2005) finds experts using one big model/theory/idea (known as hedgehogs) are worse predictors than those using simpler multiple models/ theories/ideas (known as foxes). Keil (2010) provides an interesting discussion of hedgehog and fox dichotomy in predictive and non-predictive areas of expertise. In addition, working with models, allows us to improve the models if the models turn out to be inaccurate or inadequate by continuously having a dialogue between the models and reality. When models fail, we can investigate the conditions that are necessary for them to work. Given that no model is perfect and holistic, it is useful to work with a collection of models, particularly noting that models can be limited by their scope rather than the flaws. Thus, some models are best suited to explain part of a whole system. In this regard, in order to explain how an external shock or a policy change are transmitted through a SES, it can be useful to employ a series of models – each model informing other models, and each having demonstrated strength in explaining a part of an integrated system.

The main aims of the paper are twofold: first, to frame the water policy in the context of the three interdependent and interconnected systems and, second, to propose an integrative modelling and analytical framework to analyse the socio-economic and distributional analyses of policy reforms and external shocks. Note the rationale for a systems and integrated approach to model the ecological, economic and social interactions is well established in sustainable development literature (see for instance: Barbier, 1987; Barbier and Markandya, 2013; Buchholz, 2007; and Fiskal, 2003 and 2006), and therefore will not be reviewed in this paper. The rest of the paper is organised as follows. The next section describes the MDB as a SES and how a series of models can be linked to explain the interdependences within a SES. This is followed by a section on literature review of the Computable General Equilibrium (CGE)-Microsimulation linkages to provide a background on how these models can be linked in the context of the water policy reform in the MDB. The penultimate section discusses in detail how CGE and Microsimulation models are linked in a top-down manner. This section also includes how the output of CGE-Microsimulation linkages could inform additional models to further enrich the analyses of the water policy reform in the MDB. The final section concludes the paper.

I. A CONCEPTUAL AND ANALYTICAL MODEL OF THE MDB AS A SOCIO-ECOLOGICAL SYSTEM (SES)

Ecosystems are increasingly being recognised and treated as an environmental or natural asset or capital, which provide vital services for the sustainability of the economic and social systems. Like physical capital, ecosystems deplete with use. However, unlike physical capital, ecosystems are harder to replace (and some cases impossible to replace once depleted) and maintain. The public goods nature of ecosystems and the associated market failures in the provision of ecosystem services offers additional challenges for achieving optimal balance

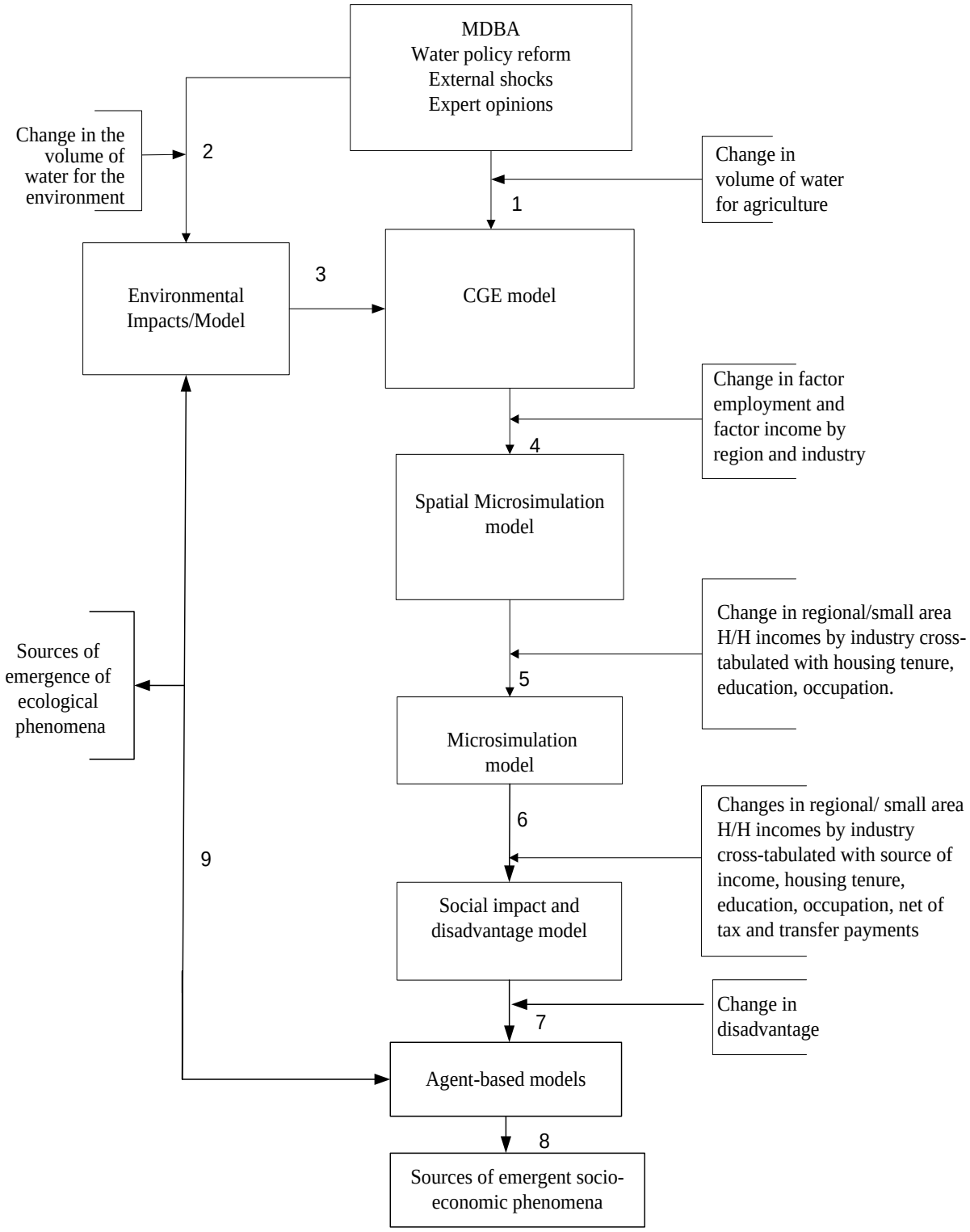
among the three main systems: the ecological, the economic and the social. Conceptually, the optimal balance in terms of sustainable development[3] is attainable where the goals of the three systems intersect (Barbier, 1987; Barbier and Markandya, 2013). Each of the systems has the desired or "human ascribed" goals (Barbier, 1987). The main goals of the economic system are economic growth and efficiency, equity and reduced poverty. The key goals of the social system are social justice, good governance and social stability. The key goals of the ecological system are biological productivity, resilience and bio-diversity. Barbier points out that maximising all the goals may not be possible all the time. For example, increasing economic productivity achievable in an efficient and equitable way may still impose some costs on the environment in terms of resource depletion and environmental degradation (thereby adversely affecting bio-diversity and resilience of the ecological system). On the other hand, maximising the goals of biological productivity and diversity has the potential to impose costs on the economic and social systems in terms of reduced economic growth and increase in unemployment and associated social problems.

It is difficult to envisage economic growth without imposing any costs to the ecosystem. In this situation, sustainable economic and ecological systems would imply an ecological-economic trade off. However, maximising the goals of one system without accounting for costs it may impose on other systems will produce less than socially optimal outcomes. Thus, in recognising the interdependence of all the three systems, sustainable development would involve maximising the "goals across all these three systems through an adaptive process of trade-offs...." (Barbier, 1987, p. 104). The process of adaptive trade-offs implies that for the systems to exist and thrive in a changing environment, they must have the capacity and capabilities to adapt and evolve. In other words, "agents within adaptive systems interact, react, learn, and co-evolve with their environment" (Buchholz *et al*, 2007, p. 6088). The water reform policy under the Basin Plan is largely about the trade-offs between the ecosystem and the economy and the social systems, and the impact these trade-offs have on the socio-economic and distributional outcomes. Thus, this interdependence of and the need to maximise goals across the three systems has influenced the approach outlined in this paper to modelling the MDB as a complete system, bringing together a number of models to analyse the policy reforms and external shocks, as described below

Figure 1 shows in more detail how a number of integrated models, where each model explains a part of the system, might be able to model the interactions and interdependences in a SES. A perturbation in one system may trigger changes in other systems directly and indirectly. The challenge is to identify the linkages and feedback loops in terms of the variables that connect the systems so that they form internally consistent components of the whole system. The MDBA has invested a considerable amount of time analysing the ecological and socio-economic impacts of water policy reform under a number of Basin Plan modelling scenarios. In coming up with various modelling scenarios, the MDBA has consulted widely with the stakeholders at the business and community levels, including various levels of government and the scientific community (see for instance MDBA, 2012a, 2012b and 2012c). The key purpose of this extensive consultation and modelling work is to get the 'right amount' of trade-off, which in the long run can restore the health of the river system and at the same time have minimal adverse socio-economic impacts.

[3] The most widely used definition of sustainable development is from the World Commission on Environment and Development (WCED, 1987) commissioned report referred to as the "Brundtland Commission" (after its Chairman). It defined sustainable development as: development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Barbier and Markandya, 2013).

Figure 1: Details of the Interfaces between the Environment/Ecology and the Socio-economic Models



To strength the modelling framework involving systems which are interconnected and interdependent, this paper proposes an integrative analytical framework by linking a series of models that can more transparently trace the impacts of policy changes and external shocks as they transmit throughout the whole system. This analytical framework (shown in Figure 1)

would be useful in simulating a number of policy or external shock scenarios to inform best policy options. While the analytical framework has been developed in the context of the water policy reform (in the MDB), it can be equally used to analyse policy and external shocks that originate from and affects the ecological, economic and social systems. Using the example of the water policy reform in MDB, the rest of the paper explains the workings the analytical framework in Figure 1.

The water policy reform enters the economy via link 1 in Figure 1. As mentioned in the Introduction, the water policy reform includes the water buyback scheme and water-saving infrastructure investments (targeting a SDL), both of which translate into reduced amounts of water available for irrigation (link 1) and increased water flows to the environment (link 2). In this modelling framework, the economy-wide, sectoral and regional impacts (including the MDB) of the water policy reform are captured by a Computable General Equilibrium (CGE) model. The output of the CGE model, largely the changes in factor employment and incomes, that affect the social outcomes across a number of household characteristics/variables nationally and regionally, including small areas are analysed with microsimulation models. First, the CGE model is linked to a spatial microsimulation model to interface with the regional detail of the CGE model (link 4). The spatial microsimulation model could be further modified and extended to include smaller geographical areas than the regions specified in the CGE model, if a smaller area analysis is desired. This brings the change in incomes and employment by industry from the CGE model to the regional/smaller area household level. The output of the spatial microsimulation model is then fed into a national microsimulation model via link 5 to compute the regional/small area level change in household incomes (cross-tabulated by household characteristics/variables) net of federal taxes and transfer payments. The changes in household characteristics are linked to changes in social disadvantage by a social impact model (link 6). Finally, agent-based models can take as inputs the output of a social impact model (such as psychological or financial stress) via link 7 to investigate emergent socio-economic phenomena such as resilient or vulnerable communities. Finally, link 9 shows the social system (human decisions and interactions) is linked to the ecosystem via agent-based models to explain the emergent socio-ecological outcomes.

The relevant features of each of these models are outlined below; including a more detailed discussion on how each of these models is sequentially linked. We begin, by first reviewing literature on linking CGE and Microsimulation models, given that these models form the core structure of the conceptual and analytical framework.

II. CGE-MICROSIMULATION LINKAGES AND THE DISTRIBUTIONAL EFFECTS

CGE models provide a rigorous way to quantitatively measure and evaluate the impact of policy reforms (such as the water policy reform under the Basin Plan) in the economy as a whole (Johansen, 1974). The CGE modelling, based on the input-output linkages of the economy, models the structure of the whole economy and therefore the details of all existing interactions among economic agents (producers, consumers, investors, government and the rest of the world). Because of this interconnectedness of markets and agents in a CGE model, the CGE analysis captures a wider range of economic impacts of an external shock or a policy reform, compared to other available techniques (such as the partial equilibrium models). In this regard, CGE models are better equipped to evaluate policy and external shocks whose impacts are expected to be complex, transmitted by different channels, and materialize not only in one but various rounds through feedback loops via interconnected markets. Moreover, given that the CGE models are designed to evaluate the economy-wide impacts, it not only captures the structural changes in the economy as a whole but also clearly identifies the

winners and losers (sectors, regions, occupations, and so forth) of a policy reform or an external shock.

However, the inadequacy of the use of CGE models for *distributional analysis* is well recognised in the income distribution literature (for instance see Savard, 2005). This is because, traditionally, CGE models include only a limited number of representative households, so do not account for the diversity of individual or household characteristics required for a detailed distributional analysis (Savard, 2003, 2005; Colombo, 2010). In this regard, a companion microsimulation model can be combined with a CGE model to analyse income distributional issues of policy change or an external shock. The strength of the microsimulation models is that they account for individual heterogeneity by making use of nationally representative household surveys of the population (Harding and Gupta, 2007). The effects of a macro policy captured by a CGE model can be passed down to a microsimulation model for detailed distributional analysis. The benefit of combining CGE and microsimulation models is that it overcomes the problem of a lack of general equilibrium effects in microsimulation models and the limitations of the restrictive assumption of representative households in the CGE model (Hérault, 2006).

In CGE-microsimulation linkage literature, there are four main approaches to linking a CGE model to a microsimulation model for distributional analysis of policy reforms and external shocks. The first approach is the integrated approach (Cockburn et al., 2010). The other three approaches involve sequentially linking the CGE model to the microsimulation model in a top down, bottom up and top down-bottom up fashion. Sequentially linking CGE and microsimulation models is also called the layered approach to distributional analysis. A layered approach to macro-micro link is considered less complex than an integrated approach as the former involves only sharing information between two standalone models.

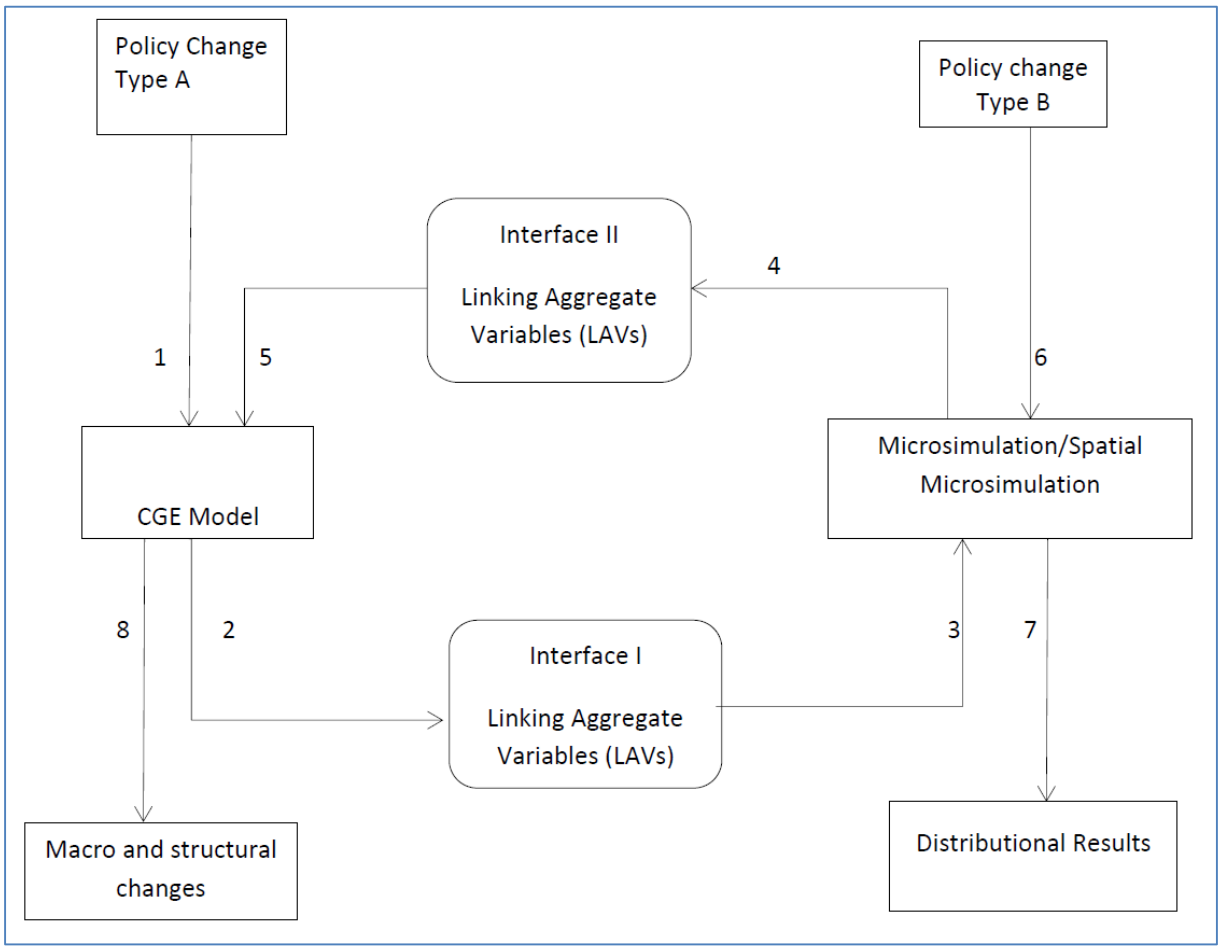
To incorporate distributional analysis within the CGE framework, one can increase the number of households in the CGE model, with each household representing a homogenous population group in the model. More specifically, this approach involves "explicitly integrating into a CGE model each household from a nationally representative household survey" (Cockburn *et al*, 2010, p. 60). This approach requires no modifications to the CGE model: the representative households are simply replaced by "real" households from a nationally representative household survey. In terms of Figure 1, the CGE and the microsimulation model now become internally consistent parts of a single model – no longer distinguished separately. In this integrated approach, as the household income and expenditure data in the model's database and the national household survey come from different sources and are likely to be from different years, these two datasets need to be adjusted and reconciled to complete the integration process.

Sequentially linking a CGE model to a microsimulation model is explained with reference to Figure 2. A top-down approach proceeds in a two-step fashion (Dixon *et al*, 1996). First, a CGE simulation of the impact of macro-level changes, induced by a policy change or external shock type A (link 1 in Figure 2), is solved. Second, its solution in terms of the selected variables of interest (such as a vector of aggregate prices, wages and employment variables), called linking aggregate variables (LAVs) are fed into the microsimulation model via Interface 1 (links 2 and 3) in Figure 2. The microsimulation model then uses the change in the LAVs produced by the CGE model to capture the changes in the distribution of income, as shown by link 7 in Figure 2.[4] In a behavioural microsimulation approach, the consistency with CGE results is largely achieved by adjusting the parameters of the behavioural microsimulation model. In the non-behavioural microsimulation approach, the consistency

[4] Note only links 1, 2, 3 and 7 are relevant in the top down approach in Figure 4 – other links are ignored.

between the two models is achieved largely by using a reweighting procedure, that is, by altering the sample weights, to reproduce the CGE results as captured by the LAVs. Studies using a top down approach include Bourguignon *et al*. (2003), Ribilliard *et al*. (2008), Lay (2010), Hérault (2006, 2007, 2010), Savard (2003), Raihan (2010), Buddelmeyer *et al*. (2009) and Verikios and Zang (2010 and 2012).

Figure 2: A Stylised Representation of CGE-Microsimulation Linkages



Source: Adapted from Dixon *et al*. (1996).

There may be cases when government policy changes or reforms may directly affect individuals and/or households, such as changes in the tax and benefit system. It may be of interest to know the economy-wide impacts of the changes in the distribution of income, labour supply and consumption patterns of households, as a result of a change in the tax and/or benefits system. In terms of Figure 2, the policy change (such as a change in the tax and benefits) enters the microsimulation model via link 6. The output of the microsimulation model (the linking aggregate variables) then enters the CGE model via Interface II (links 4 and 5) in a bottom up fashion. The CGE model adjusts to the LAVs produced by the microsimulation model to capture the macro and structural changes in the economy, shown by link 8 in Figure 2.[5] Brown *et al*. (2007) used such a bottom up CGE-microsimulation approach to assess how the health outcomes of a hypothetical diabetes prevention program affect the broader Australian economy.

[5] Note only links 4, 5, 6 and 8 are relevant in the top down approach in Figure 4 – other links are ignored.

A top-down bottom-up approach attempts to introduce a bi-directional link between the two models. The two models influence each other at various stages through feedback loops. The feedback loops are used to run both models iteratively until the two produce convergent results. If the perturbation of the system begins from the macro/CGE side (link 1 in Figure 2), then the output of the CGE model enters the microsimulation model via Interface I and in turn, the output of the microsimulation model is fed back (exogenously) into the CGE model via Interface II. This iterative process (sequentially feeding the output of one model into another) continues until both models produce convergent outputs. The final solution to the microsimulation model produces the changes in the distribution of income, shown by link 7 in Figure 2. Similarly, if the policy change originates from the microsimulation (micro) side of the system (link 6), then the output of the microsimulation model enters the CGE model via Interface II and in turn, the output of the CGE model enters the microsimulation model via Interface I. This iterative process continues until both models produce convergent outputs. The final solution to the CGE model produces the macro and structural changes in the economy, shown by link 8 in Figure 2. Bourguignon and Savard (2008) linked a CGE model to a behavioural microsimulation model in a both top-down and top-down bottom-up fashion to analyse the distributional impacts of trade liberalisation policies in the Philippines. In comparing the two approaches, the authors found the differences in the approaches were important in the presence of imperfections (i.e. wage rigidities) in the labour market. It is worth noting that in the three-layered approaches discussed above, some degree of data reconciliation is also required between the two models but significantly less than required in the fully integrated approach.

VI. THE DISTRIBUTIONAL IMPACTS OF THE BASIN PLAN

As discussed earlier, the CGE-microsimulation link overcomes the lack of general equilibrium effects in a microsimulation model on one-hand and the restrictive representative household assumptions of CGE models on the other. It is also clear that drawing on the strengths of both models allows a richer understanding of the micro impacts of (macro) policy reforms. The irrigation and environmental water policy reform under the Commonwealth's Basin Plan will affect the economy and the community in different ways as a result of structural changes in the economy. In the long-term, some individuals and households may come out winners and some as losers. In this regard, the micro (distributional) impacts of policy reforms help identify the winners, losers and the vulnerable in the communities. It therefore provides policy makers an informed basis on which to arrive at measures to help the economy and the community to adjust, including what the measures are likely to cost. The development of the CGE-microsimulation framework for distributional analysis can proceed from a top down to top-down bottom-up, followed by a fully integrated approach.

As a starting point to operationalize the conceptual framework, the rest of this paper discusses the top down approach to linking a CGE and microsimulation model to analyse the distributional impacts of water policy reform under the MDB plan. We begin by discussing the desirable features of a CGE model to analyse a regional specific shock such as the Basin Plan.

(i) Desirable features of a CGE model

For analytical purposes, the MDB spread over four Australian states and one territory is treated as a single regional economy. However, up to 40 sub-regions within the Basin are distinguished in studies of the Basin Plan capturing the irrigated (and non-irrigated)

agricultural detail and water markets in each of the sub-regions of the Basin.[6] To capture the economy-wide impact of the water policy reform, a computable general equilibrium (CGE) model would be an appropriate model to capture the flow-on economic impacts in a single analytical framework. Note that the water policy reform under the Basin Plan directly affects the MDB region. In this regard, the implementation of the SDLs is a regional-specific policy shock, originating from the MDB. From the socio-economic impact perceptive, policy makers are likely to be interested in:

1) How the policy affects the agricultural industries in the Basin, including the changes in the production/crop mix, the use of factors of production such as land and water, consumption, employment and so forth;
2) The impact that this regional-specific shock may have on the rest of the Australian economy, including the impact of any feedback from changes in the rest of the economy back to the Basin regional economy; and
3) The welfare implications of the policy on households in the Basin and the rest of the economy.

Thus, it is desirable that a CGE model for estimating the economic impact of the Basin Plan have the following key features:[7]

1) It contains the required regional and sectoral detail, in particular small region (area) representation.
2) Whether the model is dynamic: dynamic models capture both the short-run and the long-run effects of the model simulations. In addition, with regards to the Basin Plan, the dynamic nature of a CGE model allows the modeller to take into account in the baseline forecasts in the variability of water availability over the simulation period. They are also useful for policy simulations. For instance, the model can take into account a policy implementation (such as a SDL scenario) which is spread over several years or seasons.
3) Whether the model contains sectorial and regional details, including the water markets, all incorporated in a single analytical framework. Having one integrated model with interaction between different systems (economic and water) is preferable to having two separate models joined exogenously by the output of one model feeding as input into another model.
4) The model needs to incorporate inputs and factors of production that are relevant to the MDB. This will allow relevant and realistic scenarios to be derived, and will add to the flexibility of the model.
5) The model must also be designed to handle the impacts of revenues and expenditures that flow into the economy through the water buyback scheme and water-saving infrastructure investment respectively.

[6] For instance, the TERM-H20's (a 'bottom up' multi-regional multi-sectoral CGE model of the Australian economy) database distinguishes 40 sub-regions in the MDB at the statistical subdivision level (Dixon *et al*, 2012b).

[7] The two CGE models used in MDBA commissioned studies on the macro, regional and sectoral impacts of the SDLs are the TERM-H20 (Wittwer, 2011) and ABARES' AusRegion and Water Trade Model (ABARES, 2011). TERM-H20 incorporates all the 5 features listed below. AusRegion, the regional CGE model contains all the CGE features but has a separate water trade model to handle water markets that is exogenously linked to AusRegion.

(ii) A top down CGE-microsimulation link to analyse water reforms or external shocks

As a starting point to analyse the distributional impacts of water policy reform in the MDB, a top down approach to CGE-microsimulation can be used. In terms of Figure 2, the water policy shock enters to the CGE model via link 1. The results from the CGE model would capture the macro and structural/sectoral changes in the Australian economy and the regional economy of the MDB. Given the regional nature of the water policy shock, the immediate impact of the shock would be on the regional economy of the MDB and thus, the distributional impact of the structural changes in the MDB economy would directly affect the individuals and households in the specific MDB region. As pointed out earlier, the appropriate CGE model to analyse the water policy reform must capture the regional details of the MDB. As link 4 in Figure 1 shows, the output of CGE (the LAVs) is passed down to a Spatial Microsimulation model.[8] The LAVs (changes in the factor incomes by industry, employment by industry and occupation) enter the SpatialMSM, a spatial microsimulation model of the Australian economy (Chin and Harding, 2007; Tanton *et al*, 2011), via link 4. SpatialMSM then estimates the impact of changes in the factor incomes and employment by industry and occupation on household income in different family or household type, housing tenure, education level and other characteristics of the employee and income earner in the MDB regions and/or smaller areas within the MDB regions.

(iii) A top down SpatialMSM-STINMOD link

The changes of income and employment status are likely to affect a household's tax payment to the government and transfer payments from the government according to their family characteristics. In order to calculate the changes in the Commonwealth's tax and transfer payments, the output of the SpatialMSM (the LAVs) would be passed to a national microsimulation model, the STINMOD (Lambert *et al*, 1994), a static (and non-behavioural) federal tax and transfer payments model of the Australian economy. STINMOD estimates the changes in household income of federal tax and transfer payments for each different family observed in the microdata in the regions and/or smaller areas of interest in the MDB. These results allow the estimation of a number of social indicators arising from the changes in income distribution such as poverty rates (Tanton *et al*, 2009) and housing stress (Nepal *et al*, 2010). This method could also be used to measure the dependency on federal government transfer programs and what these programs are likely to cost. The social indicators after the impact of the tax and transfer system gives a comparison between the socio-economic status of individuals and households in the base case (or business as usual) scenario and after water policy reform scenario.

(iv) A STINMOD-Social Impact and Disadvantage Model (SIDMOD) link

It may be desirable to know the impact that the water policy reforms have on the social disadvantage of the communities in the Basin, especially wellbeing indicators such as financial stress, subjective wellbeing and mental health. To calculate these indicators, additional data is required beyond the output of the microsimulation models. Link 6 in Figure 1 shows the microsimulation model (STINMOD) is linked to a Social Impact and Disadvantage Model (SIDMOD). SIDMOD, largely a series of econometric models, takes inputs from microsimulation models, together with additional data from surveys such as the Household, Income and Labour Dynamics in Australia (HILDA) Survey, to estimate a range

[8] Spatial microsimulation is a technique to derive datasets for small areas (with household detail) not normally captured by the official sample surveys. In order to conduct a meaningful distributional impact of water policy reform in the MDB communities, a dataset for the Basin, which is appropriate for distributional analysis, needs to be derived using a spatial microsimulation procedure. For details of the technique, see (Tanton and Edwards, 2013).

indicators of social disadvantage (such as financial stress, subjective wellbeing and mental health) that could be affected by the water policy reform.[9]

(v) Social-ecology nexus

To complete the links and the feedback loops between the systems/models in the overall analytical framework, it may be desirable to link the microsimulation models and social impact models (via link 9 in Figure 1) to the ecological system. Agent-based model (ABMs) seems to be an appropriate model for the feedback loop from the social system back to the ecological system - in particular - how individual human decisions and interactions among themselves and with the ecology simulate observed emergent macro-scale socio-ecological outcomes (Heckbert, et al., 2010). These outcomes could include observed phenomena such as depletion of ecosystems (such as changes in the types and composition of species of plants and fauna), the emergence of land-use systems (Matthews *et al*, 2007), deforestation and reforestation (Manson and Evans (2007), governance of SES (Garmestani and Benson, 2013) and so forth.

Moreover, the microsimulation models used in the framework are static and non-behavioural. Dynamics and behavioural responses can be introduced in the framework via ABMs to explain, for instance, emergent socio-economic phenomena such the emergence of resilient or non-resilient communities (Stokals *et al*, 2013) – those communities that are exposed to prolonged climatic events such as droughts. The goal is to use ABMs to uncover and analyse the main drivers or sources of emergence (such as individual behaviours and interactions, social support networks and institutions) embedded in resilient and adaptive communities or are absent in vulnerable communities in the MDB. The ABMs are well suited to study emergent phenomena for its flexibility to model individual behaviours and their (non-linear) interactions between themselves and their environment, which rise to emergent macro behaviour that are not explainable by merely aggregating individual behaviours. Link 7 in Figure 1, shows that ABMs can potentially take as inputs the outputs of the social impact model, SIDMOD (such as measures of psychological stress and subjective well-being), together with variables not included in SIDMOD such as institutions, social networks, governance and so forth (Folke, 2006) to investigate how all these factors explain emergence of resilient and adaptive or vulnerable communities.

V. CONCLUSION

From a policy perspective, it is important to know how external shocks and policy interventions are transmitted throughout interconnected and interdependent socio-ecological systems (SES). In this regard, the paper attempts to develop a conceptual integrative analytical framework to analyse the national, regional and spatial socio-economic and distributional effects of external shocks (e.g. droughts) and policy interventions (e.g. the water policy reform in the MDB), which originate from an important regional economy such as the MDB. This is achieved by sequentially linking a series of models in a top-down fashion, each model informing the subsequent model, thus drawing on the strengths of each model designed to explain a part of a SES. It is recognised that a bottom-up regional CGE model was the appropriate model to capture the macro, sectoral and regional (including the MDB) effects of shocks that are regional-specific. However, given the limitations of CGE models for

[9] The Household, Income and Labour Dynamics in Australia (HILDA) Survey is an Australian household-based panel study, which began in 2001. It collects information about economic and subjective well-being, labour market dynamics and family dynamics. The responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research, University of Melbourne (see http://www.melbourneinstitute.com/hilda/).

distributional analysis, the output of the CGE can be passed down to microsimulation models for distributional analysis at the household level. It is worth noting that the emphasis of this paper on the effects of shocks on small areas, both in the MDB and the rest of the economy. Thus, the output of the CGE model is first passed down to a spatial microsimulation model to capture small area detail at a household level. To analyse the distributional impacts net of federal tax and transfer payments, the output of the spatial microsimulation is passed down to a national microsimulation model. To further enrich the distributional analysis at the household level, the framework proposes linking the microsimulation models to a Social Impact Model, which can use additional data from surveys such as HILDA to provide further estimation of a number of key household variables to calculate the social disadvantage indicators for households in the MDB. The framework further posits that the output from the social impact and microsimulation models, together with other variables, can potentially explain, via agent-based models, the emergence of resilient and adaptive or vulnerable communities exposed to external shocks such as droughts and subsequent policy interventions such as the water policy reform under the Basin Plan. Finally, to complete the interconnection between the systems in a SES such as the MDB (albeit in a top-down fashion), the framework proposes linking the social system (human decisions and interactions) with the ecosystem via agent-based models to explain the emergent socio-ecological outcomes.

Though the modelling framework has been developed in the context of the water policy reform in the MDB, it potentially has wide applicability, particularly if external shocks and policy interventions are regional-specific and the interest is in analysing their national, regional and spatial socio-economic and distributional effects.

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Assessing and Managing Cumulative Impacts of Mining on Regional Housing in Australia: A Case Study

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ABSTRACT

The continuous mining development in Australia, particularly in Queensland, means housing has been an important issue in the resource boom towns in recent years when housing price is soaring and housing affordability has been deteriorating. This paper develops a framework to assess the cumulative impacts of mining on housing in regional Australia, with a sub-regional approach through a case study of the northern Bowen Basin region. First, the paper proposes pressure-state-cumulative-impact-response-monitoring and evaluation (PSCRME) framework based on the relationship between planning theories and impact assessment processes. Secondly, the paper applies this framework to identify cumulative impacts of mining on housing using three case study towns from the northern Bowen Basin region. Finally, the paper provides implications of this framework in future mining development and housing planning and management in the mining towns in Australia and elsewhere.

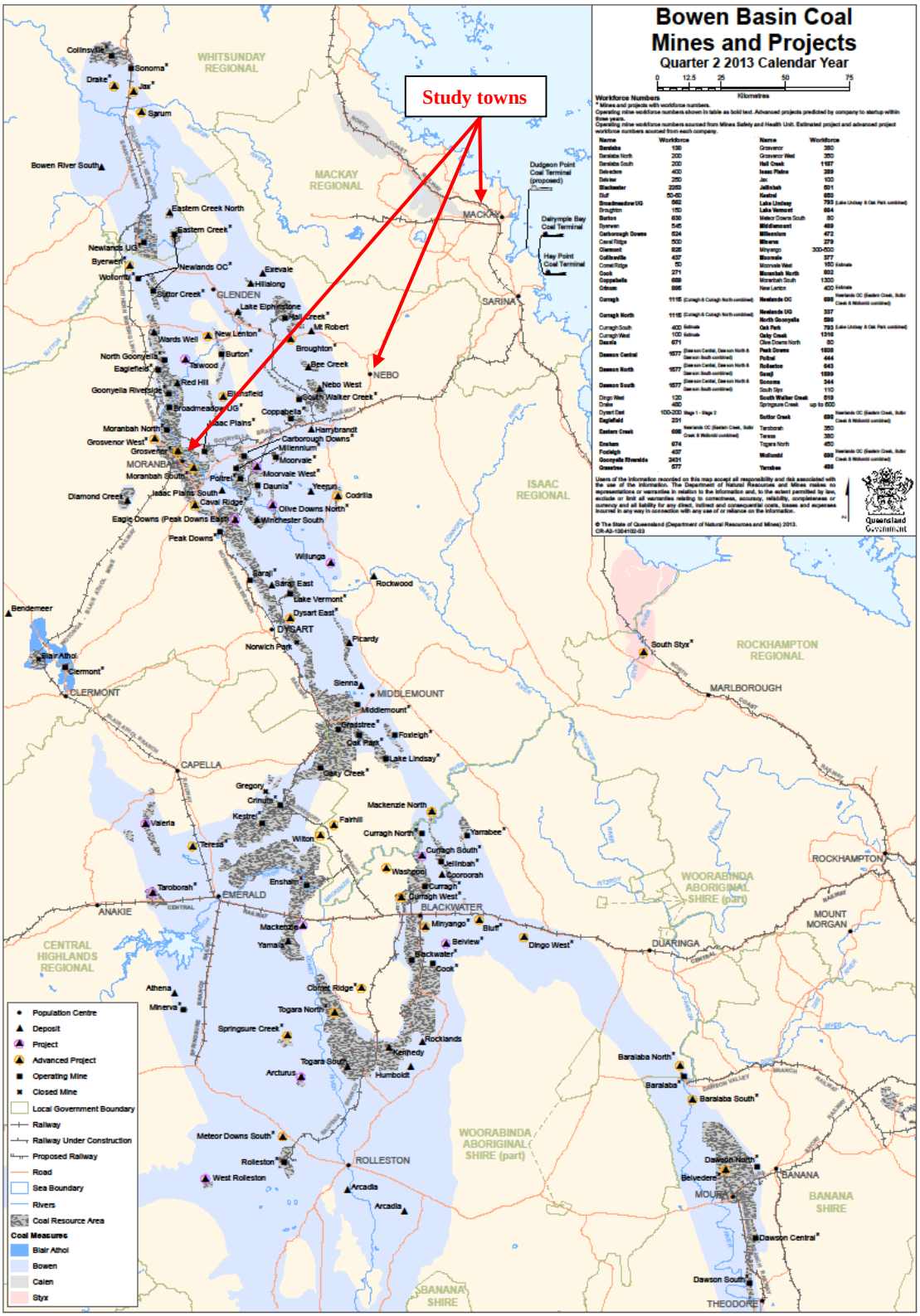
1. INTRODUCTION

The Bowen Basin region (Figure 1) is predominantly a coal mining and agricultural region within the central Queensland region in the State of Queensland, Australia. This region currently produces approximately 80 per cent of Queensland's coal from its 47 operating coal mines (DNRM, 2013). In 2011-12, 45 mines were under production, 39 increased their workforces, five reduced their numbers, and one remained unchanged (QTT, 2012). The region experienced significant population increases between 1976 and 1986 because of both mining and agricultural boom, but then its population started declining because of outmigration until 2001, with population falling from 79,600 to 71,800 during that period (OESR, 2010a). Again mining boom started at the end of 2001, population started increasing and by 2009 it recovered its population losses during 1986-2001.

Currently 107,100 full-time equivalent people live in this region (QTT, 2012). Mining industry accounted for 23 per cent of the total direct employments in this region (OESER, 2010a). In addition, non-resident workers constitute a significant proportion of the population and workforce of the Bowen Basin. In 2009, 13 per cent of the full-time equivalent population of the region were non-resident workers and now it has been increase into 22 per cent (QTT, 2012). While coal mining activities are generating a number of positive economic impacts, such as increases in employment and income, there is also evidence of some negative impacts, particularly in the housing sector. Aim of this paper is to propose and examine a framework for assessing mining impacts on housing sector and to highlighting implications of this

framework in future mining development, housing planning and management in the mining towns in Australia.

Figure 1: Bowen Basin Coal Mines and the Study Towns



Source: DNRM (2013).

This introduction forms Section 1 of this paper. Section 2 provides theoretical underpinnings to constructing an analytical framework (PSCRME Framework) to examine the cumulative impacts of mining on housing sector. This framework is applied in Section 3. The final section includes a conclusion with implications of this framework in future mining development in Australia.

2. ASSESSING CUMULATIVE IMPACTS ON HOUSING: THEORY TO PRACTICE

Planning theories, particularly political-economic mobilisation and collaborative planning theories have connections with social impact assessment processes but practical application of these theories is significantly less compared to their theoretical connections (Lawrence, 2000; Richardson, 2005). A key challenge in social impact assessment for major resource projects is to develop a framework for impact assessment and mitigation. This can be illustrated with major resource developments in the Bowen Basin in Queensland, where rapid development of new coal mines and changing employment and social patterns has led to varying and complex impacts on communities, especially on their housing (Akbar *et al*, 2009; Rolfe *et al*, 2007). Any development (pressure) makes changes to the current population and demographic structure (state), the pressures create changes (impacts on housing), and impacts need to be addressed (response) in order to maintain community sustainability. The equation of pressure, state and impact on one side and response on the other side is generally known as the 'Pressure-State-Response (PSR)' model (Akbar *et al*, 2010a). While the concept is simple it is often difficult to implement in practice.

Some researchers have extended the initial framework to reflect a 'Pressure-State-Impact-Response' (PSIR) framework (Lockie *et al*, 2009a) or 'Driver-Pressure-State-Impact-Response' (DPSIR) framework (Bowen and Riley, 2003). The PSIR framework and methodology proved useful in linking social and biophysical research and would thus appear to offer some potential as a model for incorporating social concerns within natural resource decision making (Lockie *et al*, 2009a). This framework has been used in Australia for a systematic environmental impact assessment (EIA), which includes social impact assessment (Rapport and Singh, 2006); has also been used for cumulative effects assessment (CEA) (Lenzan, Dey and Murray, 2004) and strategic effects assessment (SEA) (Gunn and Noble, 2010).

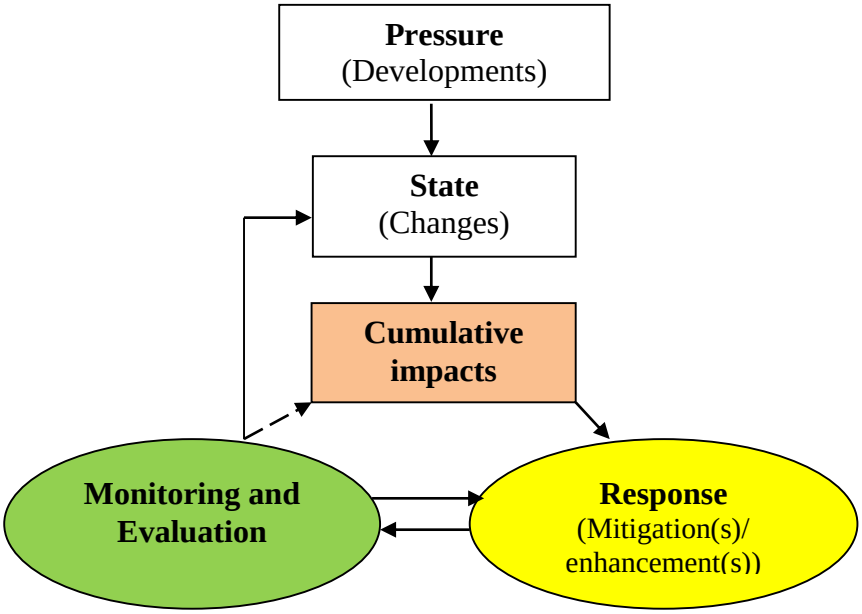
However, the PSIR model has some limitations. It focuses on isolating 'pressures', 'states', 'impacts' and 'responses', which tend to provide a static representation of the environment (situation), ignoring the significant dynamic processes that comprise the interactions between these components (Svarstad *et al*, 2008; Rapport and Singh, 2006). These limitations can be overcome by extending the model with an iterative equation comprising monitoring and evaluation (Figure 2).

In Australian most State Governments do not have Environmental Impact Monitoring (EIM) legislation relating to social impacts (Ahammed and Nixon, 2006). In part, this is likely to be because responsibilities for managing social impacts generally lie with government rather than project proponents. However the resource boom since 2001 has generated a range of different impacts on communities (e.g. Rolfe *et al*, 2007) that have created pressure on governments to be more systematic about ongoing management of those impacts.

In Queensland the government has responded to this pressure by developing the Sustainable Resource Communities Policy paper (DTRDI, 2008) where they initiated a new requirement for proponents of major projects to prepare ongoing social impact management plans (SIMPs) as a part of the SIA process. Within Queensland, the PSIR framework has been used in designing the framework for SIMPs for a particular project or project proponents (Lee and

Gibson, 2008) but not for cumulative impact of current and future project. The proposed framework would fill this gap in exploring, estimating and analysing cumulative impact of mining development at various spatial and time scales. However the framework has been applied here only at sub-regional scale, focusing of a boom period.

Figure 2: PSCRME Framework



3. APPLICATION OF PSCRME FRAMEWORK IN THE NORTHERN BOWEN BASIN

This section describes the application of PSCRME framework in the northern Bowen Basin region, in order to assess the current and future impacts of mining development. Here the area above the Middlemount (Figure 1) is regarded as northern Bowen Basin region and this sub-region is selected as a case study area because of high level of mining activities. Within this sub-region, three towns i.e., Mackay, Moranbah and Nebo are considered here as case study towns because: (1) Mackay is a typical regional hub, where mining industries receive their services as well as most of the non-resident population (e.g., shift-workers) within this sub-region live in Mackay during their off-shift period; (2) Moranbah is one of the largest and highly populated (in terms of population per square kilometre) and about 30 per cent of the total mining operation within this sub-region are around this town; (3) Nebo is typically a small mining town, which was previously a rural town. Both Moranbah and Nebo are within the Isaac Regional Council. Therefore policy implications of changes and impacts from these towns can be replicated to other regional hubs and mining towns at different geographic scale.

3.1. Pressures

Since the increase in coal prices from 2001, there has been substantial exploration and development in the Bowen Basin region (Figure 1) and 23 per cent of the employed resident population are accounted for mining industries (OESR, 2010a). Half of the mining labor force lives in the northern Bowen Basin region (OESR, 2010a). Out of 47 operating coal mines, 28 mines (60 per cent) are in the northern part of this region (DNRM, 2013). However fifteen new coal mines are either recently started their operation or will start their operation soon (Table 1) and these are either started or will start put pressures in this region.

Table 1: Forthcoming Projects in the Bowen Basin Region in the Northern Bowen Basin Region

Project Title	Capital Expenditure ($bn)	Construction Jobs	Operational Jobs	Start Date/ proposed Start Date
Isaac Plains South	$0.118B	40	80	2013
Middlemount Stage 2	$0.140B	45	500	2012
Caval Ridge	$4B	1200	500	2012
Codrilla Plains Mine	$0.15B	170	245	2014 (e)
Daunia Mine	$0.625B	450	300	2012
Grosvenor Underground	$1.115B	501	484	2012
Eagle Downs Project	$0.977B	120	360	2012
Ensham	$0.166B	Not available	674	2012
Washpool	$0.402B	400	300	2014
Olive Downs North	$0.020B	Not available	80	2013
Eaglefield Expansion Project	Not available	Not available	100-500	Not available
Ellensfield Coal	Not available	250-300	220-240	Not available
Goonyella Riverside Mine Exp.	Not available	Not available	450-500	Not available
Integrated Isaac Plains Exp.	Not available	20	40	Not available

Source: DIP (2009) and impacts assessment documents of respective mines (Note: Exp.=Expansion)

3.2. State (changes) in the northern Bowen Basin region

Northern Bowen Basin region covers most Mackay statistical division and some areas of Fitzroy statistical division (SD). The Mackay Statistical Division (Mackay SD) comprises the three local government areas of Mackay, Whitsunday and Isaac Regional Councils, which includes about 34 urban centres and localities. There were 167,666 residents in the Mackay SD at the time of ERP (estimated resident population) 30 June 2008 (MWREDC, 2010). The projected increase in population for the Mackay SD for the next 20 years is an average rate of growth of 2.2% per annum (MWREDC, 2010). This study particular focus on three towns under Mackay SD: Mackay, Moranbah and Nebo.

Table 2: Changes in Resident Population

Town	2001	2011	Change (No.)	Change (%)
Mackay	57,649	74,219	16,570	28.7%
Moranbah	6,133	8,965	2,832	46.2%
Nebo	234	459	225	96.2%

Source: ABS, 2002 and ABS 2012

Mackay was established as a sugar producing centre and then as a port city. The population of Mackay has increased by 28.7% (Table 2); this represents 2.9% population growth per year between 2001 and 2011, which is much faster than the Australian average. Moranbah and Nebo's population has increased by 46.2% and 96.2%, which is even much higher than Mackay (Table 2).

Table 3: Selected Socio-economic Medians of Mackay, Moranbah and Nebo

Town	Mackay			Moranbah			Nebo		
	2001	2011	Change	2001	2011	Change	2001	2011	Change
Median age of persons	34	35	1	31	29	-2	37	35	-3
Median individual income ($/weekly)	350	728	378	550	1275	725	450	993	543
Median family income ($/week)	850	1855	1005	1750	2828	1078	900	2200	1300
Median household income ($/week)	750	1597	847	1750	2778	1228	800	1957	1157
Median housing loan repayment ($/month)	850	2167	1217	300	2340	2040	700	1950	1250
Median rent ($/week)	125	352[a]	227	75	794[b]	719	75	425[c]	350
Average number of persons/ bedroom	--	1.1	--	--	1.1	--	--	1.2	--
Average household size	3.3	2.7	-0.6	3.6	3	-0.6	3.1	2.6	-0.7

Source: Source: ABS (2002); ABS (2012).
Notes a, b and c: Median rent of Mackay, Moranbah and Nebo belongs to 2010 data that was taken from SV (2010), which is an Australian Real Estate Search Engine.

Median age has increased by one year and median household income in Mackay has increased by $1750 between the 2001 to the 2011 census period (Table 3). Both these indicators are considered with two common trends that are occurring in regional Australia. The first is that high salaries from mine employees are impacting on locations close to resource developments and the second is that Australia's population is ageing. The median age of Moranbah and Nebo residents declined between 2001 and 2011 censuses (Table 3), reflecting the higher proportion of working age residents relocating and the loss of retirees to this town. Median incomes have had a sharp increase from the 2001 to the 2011 census period, reflecting higher incomes from increased mining employment. The median values of all other socio-economic indicators increased over the last two census periods.

Table 4: Non-Resident Population (NRP) On-Shift

Town	2006	2007	2009	2011	2012	Change	Change %
Moranbah	1915	1717	1933	2805	4585	2670	139.4%
Nebo	691	693	455	460	555	-136	-19.7%

Source: PIFU, 2006; PIFU, 2007; QTT, 2012 (Note: Government counting of NRP population has started in 2006)

In 2012, around 25,035 non-resident workers on-shift was counted in the Bowen Basin and this figure would be at least double if off-shit workers to be counted. However there is a significant increase of NRP in the Moranbah Township but there is some decrease in Nebo Township between 2006 and 2011 (Table 4).

3.3. Impacts on housing

Mackay has the highest concentration of owner occupied houses (65%), which is above the state average (52%) (Table 5 and MWREDC, 2008). On the other hand, Moranbah and Nebo have the highest concentration of rented houses (50% and 48% respectively), which is much higher than the state average (20% to 30%) (Table 5). However, 51%, 93% and 83% of the rented properties in Mackay, Moranbah and Nebo respectively are not rented through the real-estate agencies (ABS, 2008). These figures indicate that there is a greater demand for rental housing in and around the project area; and the regional town of Mackay attracts more permanent demand for housing.

Table 5. Tenure Types by the towns

Tenure type	Mackay		Moranbah		Nebo	
	No.	Prop	No.	Prop	No.	Prop
Fully owned homes	6,796	30%	512	24%	23	24%
Homes being purchased	7,989	35%	483	23%	23	24%
Rented homes	7,140	31%	1,049	50%	46	48%
Other tenure type	163	1%	21	1%	3	3%
Tenure type not stated	587	3%	49	2%		
Total	22,675	100%	2,114	100%	95	100%

Source: ABS (2008). Note: HH = Household

Impacts on vacancy rate and rental price: A review of the Mackay, Moranbah and Nebo housing and rental markets indicates a tightening market. For the March quarter of 2009, the vacancy rate for all types of residential rental accommodation in Queensland was 3.4% (increased from 2.6% in 2008, while it was 0-2% in Moranbah and Nebo (OESR, 2009). Rental prices have been increased up to 1000% in Moranbah between 2001 and 2010 (Akbar *et al*, 2010). Kleidon (2011) also reported that rental price in Moranbah started at $1500.00 and it went up to $3500.00 for a three to four bedroom house.

Impacts on house price: In line with strong growth in rental incomes, house prices within the project area have substantially increased from 2004 to 2008 and still it is moderately increasing, and the level of increase was between 58% to 239% (Akbar *et al*, 2010b), between 2008 and 2009, house prices were either stagnant for a while or declined because of the global financial crisis but it again went up at the end of 2009 (Akbar *et al*, 2010b). Volume of annual house sales appears to have peaked in these towns and the single largest annual increase in median sale prices for housing occurred prior to 2007/8, suggesting that the excessive demand for housing experienced in 2005-2007 within the northern Bowen area.

Impacts on dwelling demand: Akbar *et al*. (2011) developed a regional housing demand model, underpinned by relationships between age cohorts, household types and dwelling types and also incorporating the employment multipliers of mining employments to these three localities (i.e., Mackay, Moranbah and Nebo). The model forecasts the type and numbers of houses expected to be needed at the local and regional level over a 20 year period. The model uses secondary data from Australian Bureau of Statistics (ABS) and from the Planning information and Forecasting Unit (PIFU). This model had been applied in the Mackay, Moranbah and Nebo townships.

The number of total private dwellings is predicted to sharply increase between 2006 and 2026 in Mackay. The demand for flats/units/apartments is also predicted to sharply increase during the same period. Again, Mackay would need to provide 5547 separate houses by 2026 and 8408 flats/units/apartment by 2026 to meet the increasing demand of families with and without children and single person households (Table 6).

Table 6. Mackay Housing Demand Forecast: 2006-2036

Types of dwellings	2006*	2011	2016	2021	2026	2031	2036	Change	Change (%)
Separate house	19,337	21,114	21,229	23,160	24,886	24,885	24,884	5,547	28.7
Townhouse	1,390	2,744	4,022	4,364	4,656	4,633	4,612	3,222	231.8
Flat / unit	2,896	6,850	9,982	10,786	11,486	11,391	11,304	8,408	290.3
Other	340	427	416	447	474	469	464	124	36.5
Total private dwellings	23,963	31,136	35,649	38,756	41,503	41,379	41,264	17,301	72.2
Separate house as % of total	81%	68%	60%	60%	60%	60%	60%		

Source: Estimated by the authors.

The number of total private dwellings in Moranbah is predicted to sharply increase between 2006 and 2026, by 3,240 units. The demand for semidetached houses is always increasing. Moranbah would need to provide an additional 2,300 separate houses by 2026, which is about 110 separate houses per year and 360 semi-detached houses or units by 2026, which is about 82 semi-detached houses or units per year, to meet the increasing demand of families with and without children and single person households (Table 7).

Table 7. Moranbah Housing Demand Forecast: 2006-2036

Types of dwellings	2006*	2011	2016	2021	2026	2031	2036	Change	Change (%)
Separate house	2,087	3,185	4,096	4,287	4,391	4,389	4,387	2,300	110
Townhouse	62	194	393	412	422	422	422	360	82
Flat / unit	81	253	563	568	568	558	550	469	75
Other	90	136	194	200	203	202	201	111	124
Total private dwellings	2,320	3,768	5,245	5,467	5,584	5,570	5,560	3,240	140
Separate house as % of total	90%	85%	78%	78%	79%	79%	79%		
NPD (including SPQ)	995	2,129	4,237	4,441	4,553	4,553	4,553	3,557	357

Source: Estimated by the authors. Note: NPD = non-private dwelling; SPQ = single-person quarter.

The current rate of new housing construction in Moranbah is below these projected needs, suggesting that very high rental costs will continue. The number of non-private dwellings (NPD) is predicted in the housing model to increase by 357% by 2026, which will help to address some of the accommodation shortages.

The number of total private dwellings in Nebo is predicted to slightly increase between 2006 and 2026. The demand for separate houses is also predicted to increase during that period. Nebo would need to provide an additional 23 separate houses by 2026, which is about 1.5 separate houses per year and an extra 8 semi-detached houses or units by 2026, which is about

0.5 semi-detached houses or units per year, to meet the increasing demand of families with and without children and single person households (Table 8).

Table 8. Nebo Housing Demand Forecast: 2006-2036

Types of dwellings	2006*	2011	2016	2021	2026	2031	2036	Change	Change (%)
Separate house	77	80	84	100	102	107	107	30	39
Townhouse	0	0	0	0	0	0	0	0	0
Flat / unit	6	8	10	12	14	16	16	10	167
Other	10	10	10	10	10	10	10	0	0
Total private dwellings	93	98	104	122	126	133	133	40	43
Separate house as % of total	83	82	81	82	81	80	80		
NPD (including SPQ)	25	35	40	45	48	50	50	25	100

Source: Estimated by the authors.

Impacts of housing impacts: While house or rental price rise would have some beneficial effects in terms of increasing wealth and stimulating investment back into the housing market, there may also be some cost-pressure impacts on lower socio-economic groups who are renting, and the potential for a housing 'bubble' to emerge. Other flow-on problems that result from substantial housing shortages and price increases are pressures on lower income groups, adverse effects on the labour market for lower paying occupations because of housing affordability issues, and problems in providing administrative and social services such as education, health and policing because of housing availability issues.

3.4. Responses towards housing impacts

Here responses include both natural and planned responses from the market, government and the industries.

Housing supply: Table 9 provides a summary of the number of new residential dwellings approved for the regional council areas of Mackay and Isaac (that include Moranbah and Nebo) and new dwelling approvals have increased in the region on average by 13% per cent per annum during this period.

Table 9: Private Dwelling Approval Numbers

Region	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
Mackay	688	407	686	699	1,005	1,056	1,059	1,045	1,019	7,664
Isaac Shire	n/a	n/a	31	50	66	227	134	134	114	756
Total	688	407	717	749	1071	1283	1193	1179	1133	8420
Average annual increase (%)		-41%	76%	4%	43%	20%	-7%	-1%	-4%	13%

Source: Estimated from PIFU (2009).

PIFU (2008c) reported a significant decline in the number of residential lots approved and produced in the year ending September quarter 2008. Mackay Regional Council approved 1,609 residential lots in the year to September quarter 2008. This was a decrease of 14.6 per cent compared with the same period last year when 1,884 lots were approved. 749 residential lots were produced in Mackay in the year to September quarter 2008. Compared with the previous year when 674 lots were produced, this was an increase of 11.1 per cent. The number of lots registered in Mackay in the September quarter 2008 decreased by 44.3 per cent

to 123 registrations compared to 221 registrations recorded in the same period last year. Lot registrations in the year ending September 2008 were down 19.3 per cent over the previous year. The number of lots consumed in Mackay (RC) in the September quarter 2008 decreased by 23.4 per cent to 195 lots when compared with the same period last year. Lot consumption for the year ending September 2008 was down 1 per cent over the previous year.

Despite the availability of land in the region for new housing, slow land release contributes to an increase in the rental and house price market. There are timing, cyclical and structural reasons for this. The timing reasons relate to the very short turnaround between project approval and the start of construction, which makes it difficult for private investors to meet any shortfall. This study predicts housing demand for Mackay, Moranbah and Nebo by considering possible cumulative impacts. Results indicate that these towns will require 17,301, 140 and 43 new private dwellings by 2020 respectively. Here the cumulative impacts are based on estimated new projects and proposed labour force until 2020 in the local, sub-regional and regional area (Table 1).

Proposed mitigation or enhancement strategies: Four key areas have been identified to address at local and regional level to cope with the above housing impacts. First **temporary housing** includes the existing work camp facilities located near Moranbah and Nebo townships. **Permanent housing** includes a mix of dwelling and tenure types. **Short-term accommodation** is in short supply and includes facilities also utilised by tourism operators and by service industry operators. **Affordable housing** includes community housing providers and government funded social housing initiatives. These issues should be integrated with a housing strategy.

The main recommendations are:

- Encouraging the construction workforce, including contractors, to utilise appropriately designed workers camps to assist to alleviate the upward pressure on rents and housing costs.
- Forecasting and reviewing demand for housing in the region in partnership with Local and State Government and Housing Industry representatives to plan for the future.
- Identify strategies to help employees and their families who wish to live in local towns to find housing,
- In collaboration with industry and with social housing peak bodies monitor the demand for affordable housing and participate in the development of solutions for regional wide strategies to assist with housing provision.
- Public actions to address these issues include land release programs, supply of essential infrastructure, and other activities to stimulate housing construction.
- Strategic actions to minimise impacts in the short term might include support for elderly or disadvantaged people who have to pay higher rents and the provision of low-cost housing for students and apprentices. These support mechanisms should normally be short term solutions to address impacts while some imbalance exists between supply and demand of housing stocks.
- Having an appropriate mix of housing is important in mining communities because there has traditionally been a bimodal pattern of development between the standard 3-4 bedroom houses and work camp or temporary accommodation.
- Work camp development is a critical issue for many regional communities. Initially, the construction workforce and the contractor’s labour could stay at the workcamps; also

during the operation period, some employees are expected to live in work camps during their block shift period. This means the work camps have a role in housing mine workers in both the short term and long term. Therefore workcamps should not be treated as separate to the town development issues, and should be part of housing development options. There may be a role for State Government prepare and provide standard guidelines for work camp design and development.

3.5. Monitoring and Evaluation

It assumes here that the regional council (currently legitimate body of local service provision and monitoring) will do monitoring and evaluation of the proposed above actions or a community development committee (CDC) can monitor the actions of impact management. Here an impact, response and monitoring matrix (Table 10) is provided as an easy reference guide with only one example, to the project proponents, governments and the community in order for a communicative process to be developed in which concerns and issues can be raised and appropriate actions undertaken.

Table 10: Impact-Response-Monitoring Matrix

Impacts	**Responses**				**Monitoring & Evaluation**
Potential impact(s) and scale	Mitigation/ enhancement	Responsibility	Proposed action(s)		
			2011	2012 and afterwards	
e.g., Increase demand for short-term accommodation for the new and proposed mining projects within the region.	Refurbish and extend work camps with sufficient sports, social, recreation and ICT facilities to fulfil demand of the shift-workers.	• Coal companies • Private camp operator • Isaac Regional Council (IRC)	Start refurbishing or increase capacity of the existing work camps	Building new work camps with appropriate facilities	• Isaac Regional Council • Community development committees • Coordinator General of Queensland

This impact mitigation and enhancement matrix is intended as a 'living' document to be refined and clarified as part of broad negotiated agreements between the relevant stakeholders. The issues were drawn from observations of some current mine sites and supplemented through investigation of community and stakeholders with an interest in the development.

4. CONCLUSION

Mining development in the regional communities in Queensland changes population size and demographic structure and then it impacts on housing and accommodation. This paper helps to frame a complete and iterative framework of estimating impacts, undertaking responses and monitoring and evaluation of the responses within the total impact management system and it has been applied in a sub-regional scale at the northern Bowen Basin region. The framework particularly fills the gap in impact monitoring and evaluation processes. This is a process framework that incorporates the development of a number of strategies, impact identification and mitigation measures to address the potential negative impacts at the local community, sub-regional and regional levels.

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An Integrated Economic Framework to Assess Primary Health Care Systems in Rural and Regional Australia – A Case Study of CQML Services

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ABSTRACT

This paper focuses on developing an integrated economic framework to estimate the economic impacts of primary health care providers in Australia through a case study of the Central Queensland Medicare Local (CQML). This integrated economic framework is a combination of unit cost, regional input-output analysis, relative change and averting income loss analysis. CQML is a primary health care organisation servicing the central Queensland region in the State of Queensland, Australia. This study found that the total impact of CQML on Queensland's economy in FY 2012-13 is expected to be $20.68 million, while $12.68 million is flow-on impacts. The CQML services also helped averting $158,190 to $66 million income loss of the patients, who had received CQML services. This integrated economic framework can be used to assess other primary health care systems at different geographic level and also can use for future resource allocation of primary health care services to rural and regional Australia.

1. INTRODUCTION

Efficient primary health care systems can help decrease hospitalisation rate, health inequalities and burden of diseases and increase better health outcome and productivity of a nation (DHA, 2009). In Australia, Commonwealth, state and territory governments together delivered primary health care services, through both public and private funding. However, private services such as patients' access to general practitioner (GP) services are mostly supported by Medicare rebates. 'Medicare was introduced in October 1984 with the intent to provide a simple, fair and affordable insurance system that provided basic health cover to all Australians, building on the existing fee-for-service billing arrangements' (DHA, 2009, p. 14). Then in 1991, Australian Government introduced General Practice Reform Strategy in 1991, established the Divisions of General Practice in 1992-93, Allied Health Service program in 2000 and Allied Psychological Services (ATAPS) Program in 2006. While the primary health care sector services targeted to delivering services to all but it is less successful at dealing with the needs of people with more complex conditions or access to the services by the people of rural and remote Australia (DHA, 2009).

NRHA (2011, p. 3) found that Australian rural, regional and remote areas residents in 2006-07 experienced major deficits in per capita expenditure through Medicare Benefits Scheme (MBS), the Pharmaceutical Benefits Scheme (PBS) and admitted patient services in private

hospitals. In 2006-07, there was a shortfall of $12.6 million and $500 million MBS-funded services and PBS benefits (i.e., equivalent to 11 million scripts a year or short fall of 3.6 MBS/PBS services per person) in the rural and regional Australia (NRHA, 2011). Shortfalls of health care services were 14% (inner regional area) to 41% (very remote area) in the rural Australia in 2006-07 (NRHA, 2011).

To address such shortfall as well as to improve the efficiency of primary health care services, Council of Australian Governments (COAG) National Health Reform Agreement (NHRA) established a framework for Medicare Locals in August 2011 (COAG, 2011). Aim of this initiative was to drive regionally tailored primary health care services to improve population health outcomes and reduce inequalities (DHA, 2011). One of the preconditions of establishing Medicare Local is to do a need analysis on a prescribed structured form supplied by Australian Government Department Health and Ageing (DHA, 2011), however economic efficiency of the services has not yet been measured. In fact, Medicare Locals are delivering services to some regional and rural areas in Australia, where other primary health care services also exist; and therefore it is a challenge to measure their economic efficiency based on the input and output data. This paper focuses on to filling this gap and developing an integrated economic framework that can estimate the economic efficiency of the services provided by the Medicare Locals through a case study application of Central Queensland Medicare Local (CQML).

This introduction forms Section One of this paper. Section Two provides a snapshot of Australian primary health care systems followed a description of the case study organisation i.e., CQML in Section Three. An integrated economic framework has been developed in Section Four to examine the economic impacts of CQML services, and findings and analyses from application of this framework have been reported in Section Five. The final section includes a conclusion with implications of this framework in future resource allocation for health care services in the rural and regional Australia.

2. AUSTRALIAN PRIMARY HEALTH CARE SYSTEMS: POLICY INITIATIVES

The federal and the state governments of Australia have indicated a strong commitment to delivering a better health service; and the key policy initiatives include establish MBS and PBS systems for medical and medicine rebates, empowering local hospital boards, improving mental health services, increased funding for health research and improving access to medicines (DoH, 2013; DHA 2009). The stated government policy is to strengthen the universal health provisions of Medicare by supporting the private health insurance rebate and encouraging more Australians to take out private health insurance. Federal government also has an aspiration to improve and restore dental services through the Medicare system. Overall Federal government is responsible for health insurance and this allows it to see that Medicare dominates in this space; however the state and territory governments are responsible for about three-quarters (by value) of health services via the State Hospital system.

In 2011, COAG has established Medicare Local to decrease the current demand for services in the public hospital systems and to improve the overall health of rural and regional residents. Each Medicare Local organisation is responsible for assessing the health care requirements and for prioritising programs, services, coordination approaches and funding allocations within their catchment areas. While the few private health insurance companies are relied upon to keep the private system viable, out-of-hospital programs such as Medicare Local are positioned to provide genuine coordinated and multidisciplinary primary healthcare as well as quality efficiency synergies to the overall health system (Wiese et al., 2011, p. 998; Gardner et al., 2013, p. 56).

Research from the Australian Health Care Reform Alliance (AHCRA) and others (cited in Gardner et al., 2013) has however expressed some concerns over the capacity of some Medicare Locals to meet the objectives of building an integrated and accessible primary health care system with local GPs, allied health practitioners and consumers. The concerns focus on issues such as the timeframes given to Medicare Locals to establish viable partnerships and cultural change, and certainty and adequate control over the funding (McBride, 2012, p. 6). Health sociologists (Collyer and White, 2011) have argued that the structural reform initiated by Medicare Locals is a beginning of privatisation of the public health system by establishing non-profit corporate entities.

One of the central concepts of the Medicare Local initiative is its role and capacity to engage in coordination within the local health care system. The coordination of care within health care systems is viewed as a key component; however it is not always clearly articulated or for that matter assessed in a meaningful way against set criteria (Banfield, *et al*. 2013). Three dimension of coordination identified are informational, relational and management continuity, especially in relation to case management processes across organisations (Banfield *et al*, 2013). Identified as shortcomings to appropriate coordination of health services were issues of accessibility and continuity of case management information and a focus on system level factors instead of being responsive to local factors within a local context (Banfield *et al*, 2013).

This type of critique of the Medicare Local initiatives highlights the importance of systematic and comprehensive reviews of the performance of each Medicare Local; an economic evaluation can be a starting point to assessing technical efficiency of Medicare Locals and that is why this paper focuses on developing an economic framework that can assess economic performance of Medicare Local.

3. CENTRAL QUEENSLAND MEDICARE LOCAL

CQML is a primary health care organisation servicing a population of about an area of approximately 210,000 square kilometres since 2012 (DSDIP, 2013). This area is primarily supported by federal and state government health care and hospital systems as well as by private medical and GP systems. CQML aims to coordinate primary health care delivery and address local health care needs and health service gaps. CQML is a partnership between the Capricornia Division of General Practice and the Central Queensland Rural Division of General Practice. CQML is currently structured as a not-for-profit company limited by guarantee with an independently elected Board of Directors. The organisation has a main office situated at Rockhampton, and with additional facilities in Gladstone, Biloela and Emerald and smaller offices in Woorabinda, Blackwater and Springsure (Figure 1).

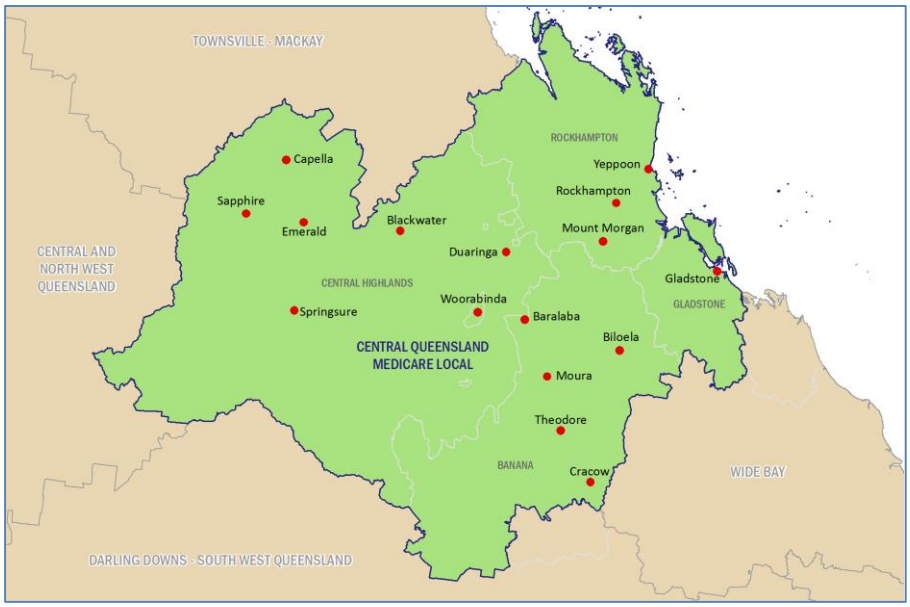
The aim of CQML was to improve the population's health outcomes and to reduce inequalities in the provision of services to those who require the health services. CQML has undertaken a prioritisation of the health services required for the Central Queensland Health catchment area and subsequently includes the following services as part of a comprehensive suite of initiatives (CQML, 2013a):

- Clinical services include nursing, midwifery, speech therapy, occupational therapy, physiotherapy, podiatry, diabetes education, psychology, social work, drug and alcohol counselling, dietetics and nutrition. Also clinical support programs with staff who work closely with general practices and allied health clinicians on areas such as immunisation, e-health, tele-health and education.

- An indigenous health unit to provide clinical and support services to indigenous people in the region.
- Health promotion with a particular emphasis on healthy eating provided by nutritionists, dieticians and health promotion qualified staff. The work includes group therapy, events, specific health projects encouraging people to be fitter and liaison with State wide health promotion programs.
- After hours services in Emerald and across the region.

This paper assesses the economic benefits of the above CQML services and their investment at local and regional level by using an integrated economic framework as developed below.

Figure 1: CQML Service Areas



Source: (CQML, 2013a).

4. INTEGRATED ECONOMIC FRAMEWORK AND DATA SOURCES

Defining input and output of any health care system is most important in start estimating the efficiency and effectiveness of this sector. Input variables of health care sector are well defined but output and outcomes variables are complex and relative to the context (Yu, 2011). Yu (2011, p. 10) divided the production and consumption of health care services into five categories given below:

1. Inputs: nurses, doctors, technicians, administration staffs, drugs, medical tools and equipment, clinics and hospitals, catering, etc.

2. Activities: clinic and hospital visits, physical examinations, diagnostic tests, surgeries performed, sessions of therapy, etc.

3. Products: courses (episodes) of treatment, number of cases adjusted for severity, lengths of treatment, quality of care, etc.

4. Consequences: health status of patients adjusted for environmental and socioeconomic factors.

5. Welfare: The overall welfare of consumers combining health status with consumption of other goods and services.

The first three elements are regarded as input and output variables and the rest two are outcome variables. This paper is only focused on input and output variables to estimate the economic efficiency of CQML services because of its nature and scope of its services (see detail in the previous section) and exiting available data; however a full economic evaluation of CQML services is not possible to do because an full economic evaluation (i.e., cost-minimisation, cost-effectiveness analysis, cost-utility and cost-benefit analyses) requires consequence data of any health intervention or systems (Peacock *et al*, 2001); and CQML does not have such data and on the other hand CQML is not the only provider in the CQ region in providing such primary health care services. Therefore the study developed a partial integrated economic analysis to assess the economic efficiency of the CQML services within the CQ region; and this integrated economic analysis is a combination of unit cost, input-output analysis, averted income loss and relative change. The first two methods will estimate comparisons and impact of the investment with national health cost data (i.e., direct input variables) and propensity to consumption. The latter two methods are related to output variables.

Unit costs are input costs divided by an output variable (Peacock *et al*, 2001). CQML provided expenditure data under five different expenditure types. The unit cost of each type of expenditure was then calculated by dividing staff numbers, patients served, number of session and number of patient hours. These unit costs were then analysed against averaged national unit cost figures.

A regional input-output model can calculate the multiplier effects of direct health budget spending on operations and staff by CQML to provide it services and such as model has recently been used by Rutsohin and Kent (2010). The input-output method looks at secondary (indirect) and tertiary (induced) spending which occurs as a result of the initial health investment. The secondary or indirect impacts flow from the businesses which have received income or other benefits from CQML and then re-spend a portion of this back into the catchment area. The tertiary or induced impacts are derived from those directly employed by CQML or those who are contracted directly or indirectly by CQML.

Relative change analysis is a comparison of one variable over a period of time (Yu, 2011). In this study the relative changes of emergency department (ED) patients were calculated based on: (1) how many patients (increasing or decreasing) over a twelve month period: and then (2) the percentage of increase or decrease over the time period: and (3) this was then converted from fractional values to a percentage format. The relative performance of ED has been derived from the above procedure however the total patients time saved within the ED was calculated by multiplying total number of patients relatively decrease with average hours taken by each patient.

An averted income loss analysis was completed by identifying how many patients where within the working age bracket (15-64 years) (ABS, 2012), then multiplying by the labour force participation rate within the CQ region, and then, multiplying by their daily average income per capita, up to a one year period.

5. FINDINGS AND ANALYSIS

This section presents findings of the above methods and analyses the findings in terms of national or state level benchmarks.

Unit cost analysis: About 79 per cent of CQML staff are providing medical services (Table 1), which is higher than the national average (71.9 per cent) of public hospital staff in 2011-12 (AIHW, 2013a and 2013b), and even once CQML fills all listed positions within CQML, the

percentage of medical services staff will be higher again. As a benchmark however, a Victorian based study has recommended that a viable GP practice should have at least 80 per cent medical services staff supported by 20 per cent general services staff (VGDHS, 2009), which seems CQML spending their budget within the standard Australian benchmarks.

Table 1: CQML Employment

Service sector	EFT* (Planned)	EFT* (Current)	Per Cent (Current)
Program staff	24	20.0	30.1%
Clinical service staff	28.7	24.2	36.5%
Corporate service staff	7.15	7.4	11.1%
Finance staff	5.6	4.6	6.9%
Strategy staff	2.8	0.8	1.2%
CEO Office	2	2.0	3.0%
Contractor (clinical services)	7.4	7.4	11.2%
Total	**77.65**	**66.4**	**100.0%**
Medical services staff	81%		79.0%
Support staff	19%		21.0%

Source: CQML, 2013b (Note: EFT = Equivalent to full time)

Average expenditure per patient for CQML services is $2,091 (Table 2), while per patient hospital expenditure is $2,151 and per capita health expenditure is $6,032 (AIHW, 2013b), which indicates that CQML is providing cost effective services compared to the national per capita health cost and hospital expenditure. In addition, CQML expenditure per staff is $128,164 (Table 2), which is lower than average expenditure per staff of the Australian public hospitals ($149,100 at 2011-12 prices) (AIHW, 2013b).

Table 2: CQML Funding and Expenditure

Types of expenditure	2012-13 expenditure	% of the total	Average cost/staff	Average cost/ patient	Average cost/ session	Average cost per hour of service
Staff salary and wage costs	$4,501,256	52.9%	$67,841	$1,107	$171	$209
Operation and management costs	$1260872	14.8%	$19,003	$310	$48	$58
Program delivery and services contract costs	$2741556	32.2%	$41,320	$674	$104	$127
Total expenditure	**$8,503,683**	100.0%	$128,164	$2,091	$322	$394

Source: CQML (2013b); AIHW (2013a and 2013b); estimated by the authors.

However, this findings needs to be interpreted with care as CQML has been providing primary health care services whereas Australian public hospitals provided primary to tertiary health services, and tertiary health services are more expensive than primary health care services. The research team was unable to locate Australia wide data giving a breakdown of primary and tertiary health care costs, and is therefore unable to make direct comparison between CQML and Australia wide primary health care services for comparing the units of expenditure.

Input-Output (I-O) analysis: This analysis is focused on the value of CQML to the state of Queensland using input-output analysis. The impacts are identified in terms of four key indicators (i.e. output, value added, income and employment) at the Queensland state level. Input-output (I-O) analysis is a widely used analytical technique to describe the effects of a sector(s) on the economy. Input-output analysis involves the use of multipliers to measure the response of the economy to the initial stimulus from sector(s) and/or final demand. Two types of multipliers are commonly used. Type I multiplier is related to the effect at the sectoral level. Type II multiplier counts the additional effect at the household level.

There are several limitations of I-O modelling such as, fixed coefficients that are not changed by an economic event or policy action, and a lack of supply side constraint. Therefore, it is recommended that caution be used when interpreting the results of the economic impact assessment using I-O analysis. If the flow-on impacts are used they should be based on Type I multipliers, because Type II multipliers tend to assume that consumption patterns will remain the same despite possible changes in economic activity in the region. It should be noted that the estimated effects may be likely to overestimate the real benefits of the sector to the state economy, hence the need for some caution.

In developing the I-O model, the Queensland I-O table which was, in turn, constructed using the latest National I-O tables (ABS 2013) were used. The Queensland I-O table were used to analyse how the stimulus in health sector of the economy flows across the range of other sectors including households. The existing Health Care Services Sector in the National Input-Output tables was assumed to be representative of CQML activity as while the majority of CQML clients were from Central Queensland, there were clients from other parts of the state such as Brisbane. The impacts estimated are presented in 2010 dollars. The total level of health sector provided by CQML activity amounted to $8m for 2012-13 and this was assumed to be the total amount of output for 2012-13 for the I-O model.

The impacts of the CQML on the Queensland economy are shown in the following indicators:

- Gross regional output: the gross value of business turnover
- Value Added: the difference between the gross value of business turnover and the costs of factors of production brought in to produce the output,
- Household income: compensation of employees including wages and salaries,
- Employment: the number of full –time equivalent people employed, including full-time and part-time,

The impacts are also summarized in terms of how they transfer into the economy as follows:

- Initial stimulus: this represents the contribution made by the sector specifically to the economy,
- Direct impacts: this represents the direct flow-on effects that the sector has into the business sector through the purchase of goods and services from other sectors in the economy,

- Indirect impacts: this represents the effects on other businesses as a consequence of the direct effects,
- Induced impacts: this represents the induced impacts on final household demand as a consequence of higher employment across all sectors.

Type I (Closed Model) multipliers include the direct and indirect business spending. Type II (Open Model) multipliers include direct, indirect spending and household spending as a result of higher employment and therefore a larger total income across all sectors.

The analysis of the I-O multipliers for the health care services sector indicated that there is an impact on Queensland economy in terms of employment, output, income and value added (Table 3). Table 3 shows that for each ten employees hired in the health sector, there are an additional seven persons employed because of indirect and induced effects. Each $10 of sales in the health sector will result in an additional $16 of revenue generated because of indirect and induced effects. For each $10 of sales in the health sector, there is an additional $7.5 of income generated because of indirect and induced effects. For each $10 of sales in the health sector, there is an additional $12 of value added because of indirect and induced effects. Table 4 summarises the economic effect of CQML activity on the Queensland economy.

Table 3: CQML Health Sector Multipliers, Queensland

Output	**Queensland**	**Income**	**Queensland**
Initial	1.00	Initial	0.52
First Round (Direct)	0.25	First Round (Direct)	0.07
Industrial Support (Indirect)	0.18	Industrial Support (Indirect)	0.04
Consumption (Induced)	1.15	Consumption (Induced)	0.29
Total	2.59	Total	0.92
Type I	1.43	Type I	1.21
Type II	2.59	Type II	1.75
Value Added		**Employment**	
Initial	0.67	Initial	8.52
First Round (Direct)	0.12	First Round (Direct)	0.99
Industrial Support (Indirect)	0.09	Industrial Support (Indirect)	0.61
Consumption (Induced)	0.61	Consumption (Induced)	4.61
Total	**1.48**	**Total**	**14.73**
Type I	1.31	Type I	1.19
Type II	2.21	Type II	1.73

Table 4: CQML Health Sector Impact on Queensland Economy

Type of impact	Industry Output, $M	Value added, $M	Household Income, $M	Employment, persons
Initial	8.00	5.35	4.20	68.20
First Round (Direct)	2.02	0.98	0.54	7.90
Industrial Support and induced (Indirect)	10.66	5.53	2.62	41.74
Total	20.68	11.86	7.36	117.84
Flow on effect	12.68	6.50	3.16	49.64

Source: Estimated by the authors.

The direct impact of CQML on Queensland is expected to be $2.02M, the indirect and induced impacts is expected to be $10.66M resulting in a flow-on effect of $12.68M. The combined direct, indirect and induced (value-added) impact of CQML activity on the Queensland economy is expected to be $12.86M. CQML operations are therefore expected to result in an additional $6.5M of value (value added) to the Queensland economy. The CQML services directly increase employment by 118 FTE.

Relative changes (increase or decrease) in patients in the two main regional hospitals (i.e., Rockhampton Base Hospital and Gladstone Hospital) have been estimated in this study based on their Emergency Department (ED) patients' admission records (NHPA, 2013). It found a 52.2% and 110.9% decrease of the ED patients in the two hospitals in 2012-13 and one of the reasons of this decrease can be attributed to CQML services (Table 5).

The relative decrease equates to a saving of 16,510 hours of patient time from these hospitals (Table 5). In addition, relative decreases of ED patients help increase relative performance of the ED services for 2012-13 by 7.9% for Rockhampton Base Hospital and 15.6% for Gladstone Hospital.

Table 5: Relative Change (Decrease) of Patients in the Emergency Department of Rockhampton Base Hospital (RBH) and Gladstone Hospital: 2012-13

Hospital	Total increase	Increase %	Relative decrease	Relative decrease %	Total time saved (hrs)	Relative performance increase
RBH	389	0.8	425	52.2	8300	7.9%
Gladstone Hospital	-10	0.04	1145	100.9	8210	15.6%

Under an averted income loss analysis, the study found that 2578 patients of all CQML patients (88%) are within the working age (15-64 years) category, which means CQML services impacted on averting population income loss by providing their services in the rural and regional areas. The labour participation rate in the CQ region is 68.15% (DSDIP, 2013) and we multiply working age patients by labour participation rate then we found at least 2438 patients were engaged in paid employment at the time of receiving the health services from CQML.

If the CQML services are able to avert patients' income loss through the prevention of absenteeism because of ill-health, then the services help return at least $158K to the region for each day of absenteeism prevented for the total CQML working age cohort (Table 6). Average income per day has been taken from ABS (2012). However, as this study does not have any direct data on the level of absenteeism prevented from CQML services compared to the traditional services provider(s) or how quickly the patients regain their health because of CQML services; there are a number of assumptions made in Table 6 (below) to estimate the CQML patients' averting their income loss within the CQ region.

If all patients save at least one day equivalent working day by getting CQML services, then the total amount of CQ regional productivity gain is estimated as 158K (Table 4); and the same assumptions were made for other days, weeks and years respectively. Patients absenteeism due to ill-health within the rural part of the CQ region were estimated by subtracting the total CQML patients from Rockhampton Regional council patients, and then multiplying by the working age percentage and the labour force participation rate. The similar processes have been maintained in finding out the patients return to work within the rural part of CQ region except Gladstone. Rockhampton Regional Council (including Livingstone Shire

Council) has been considered as a health service area covered by a large regional hospital i.e., Rockhampton Base Hospital. The area outside this region is assumed as a rural service area.

Table 6: Productivity maintained by CQML services

Averting income loss	Amount – whole of CQ region	Amount – rural part of CQ region	Amount – rural part of CQ region except Gladstone
For a day equivalent	$293,730	$200,479	$158,190
For two days equivalent	$587,460	$400,957	$316,380
For three days equivalent	$881,191	$601,436	$474,571
For a week equivalent	$1,468,651	$1,002,394	$790,951
For a month equivalent	$6,462,065	$4,410,532	$3,480,185
For a year equivalent	$66,089,304	$45,107,712	$35,592,804

Source: Estimated by the authors

6. CONCLUSIONS

Estimating the economic impact of the Medicare Locals' services is an important dimension in evaluating the new initiative that started to coordinate primary health care service delivery and address local health care needs in rural and regional Australia. This study developed an integrated economic framework to assess the economic impacts of CQML services, which includes unit cost analysis, input-output (I-O) analysis, averted income loss analysis, relative change analysis; and then this framework was applied to assess the economic impacts of CQML services.

This study found that average expenditure per patient for CQML services is lower than the hospital services and overall health expenditure in Australia. However, this findings need to be interpreted with care as CQML provides primary health care services but the hospitals provide primary to tertiary health services, and tertiary health services are generally more expensive than primary health care services. Flow-on effects of CQML expenditure is expected to be $12.68M within the state of Queensland.

There was a relative decrease in patients in the two main regional hospitals (i.e., Rockhampton Base Hospital and Gladstone Hospital) in 2012-13 based on their Emergency Department (ED) patients admission are 52.2 per cent and 100.9 per cent respectively, and it helps increase relative performance of the ED services by 8 per cent to 16 per cent. This improvement in performance can be attributed to the effects of additional services provided directly by CQML and in addition the flow-on effects of an increase in coordination of services in the CQ region. However this study is limited in the extent to which it can calculate the direct effects based on the available economic data. In addition, CQML services helped to averting between $158,190 to $66 million incomes losses depending on the length of time the patients benefitted from CQML services, via the saving of patients' income generating working time. This integrated economic framework can be used to assess other primary health care systems at different geographic level and also can use for future resource allocation of primary health care services to rural and regional Australia.

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Community Preferences for Digital Futures: A Regional Perspective

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ABSTRACT

The objective of this study was to understand community preferences for digital futures in the Southern Downs Region in Queensland, Australia. The study examined the strengths, weaknesses, opportunities and threats of the digital future in the regional context. The methodology applied in this study included three focus group discussions (FGDs) along with a structured questionnaire survey for the participants. Some key suggestions which evolved from the FGDs are that digital services need to be cost-effective and people from low socio-economic backgrounds may require specific supportive measures. A consensus emerged that the provision of the vital digital education needs to be at low or subsidised cost at remote areas. It is therefore important to have a comprehensive understanding of community needs, demands and barriers to adoption to come up with a digital economy strategy for the future. While the FGDs provide an avenue for basic understanding of the broad range of issues at the community level, further micro-level analyses that shed light on the adoption and effects of digital technology on households and businesses are clearly warranted.

1. INTRODUCTION

Despite the overwhelming evidence on the influence of information and communication technology (ICT) to societies and economies, its diffusion and adoption in rural and regional areas still remains poor (Galloway and Mochrie, 2005). Recent data confirm that the rural and remote areas are in a disadvantaged position in terms of various socio-economic indicators as compared to the urban counterparts (ABS, 2013a). People of these areas in general experience barriers to education and workforce participation, poor health outcome, social exclusion and welfare dependency (ABS, 2013a). It is expected that ICT can bridge some of the gaps as it can potentially help to diminish the negative effects of distance by increasing the access to information, providing a better provision to services and training and reducing the transaction cost, thereby, creating the potential of economic and social take-off for the rural economies and society (Herbert-Cheshire, 2000). However, while a general trend of ICT diffusion can be found virtually everywhere, the extent of growth is not persistent everywhere, especially in the rural and regional areas.

The objective of this paper is to understand the community perception of digital technology in the regional area. More particularly, this study evaluates whether rural population consider ICT as an opportunity to explore greater economic and social possibilities. This was achieved through by conducting three focus group discussions (FGDs) in Stanthorpe – a rural area in

regional Queensland. In Australia, it is recognized that despite significant increase in the level of computer usage and Internet uptake in recent years, there still exists a gap between 'haves' and 'have nots' in terms of access to and/or use of the Internet – a phenomenon popularly known as 'digital divide'. It is argued that social inclusion through social interaction at the community level could play a vital role to narrow digital divide at the regional level (Broadbent and Papadopoulos, 2013). Yet, there is little understanding of community needs, demands and barriers to adoption, especially using recent information. The study fills up the gaps in literature by considering a case of regional Australia.

The organization of this paper is as follows. Following this introduction, Section 2 provides a brief overview of the concept of rural community development in the information age and sheds lights on the Australian context. Section 3 discusses the methodology and data. Section 4 presents the study results and Section 5 provides conclusions and policy implications..

2. RURAL COMMUNITY DEVELOPMENT IN THE INFORMATION AGE

The concept of rural community development remained ad-hoc and under-researched for many years (Summers, 1986). Conventionally, the wisdom rural development has largely been concentrated around the agricultural policies 'topped up' by measure of social welfare (Ellis and Biggs, 2002). Since the 1990s, however, greater attention has been shown at the community level with the rise of community self-help and empowerment ideas within the discourses of rural development (Herbert-Cheshire, 2000). Empirical evidence provide evidence that community-led approaches that focus on capabilities and skills, leveraging local resources and institutions can play an important role in building a successful rural community (Terluin, 2003). ICTs can be regarded as a basic resource in the context. Unfortunately, the provision of ICTs remains dispersed and access to various information services tends to be difficult when considering the case of remotely located and socially disadvantaged populations.

Community, by definition, refers to "certain social relationships in the life space of the person, which, it is argued, serve both as a means of achieving social well-being and as a definition, or end, of its realization" (Wilkinson, 1979, p. 7). The micro unit of the community is household, which is then aggregated in terms of pursuing similar economic and social interests. Households are the suppliers of labour as well as the consumers of goods and services produce. In order to play such roles, households need to interact with the external economic agents that make up the community economic system. Therefore, community needs to maintain channels of communications, cooperation and interaction with different agents in order to attain goals of economic development.

There are various ways ICT can shape rural communities to foster economic growth and developments. This can be conceptualized in two ways: firstly, in terms of how they contribute towards reducing the friction of distance, and secondly by how they facilitate remote regions to improve their knowledge base as 'learning regions' (Grimes, 2000). It is believed that access in ICT can lead a major transformation to access to the low-cost and real-time information gateway. ICTs have the full potential to build information and knowledge society, which in turns helps to achieve sustainable economic and social development (Kamba, 2009). Therefore, considerable enthusiasm has been grown in recent years to use ICTs to foster local community ties through education, job opportunities, encouraging community activities and increasing general sociability.

In the Australian context, despite the robust growth performance of the country over the last two decades, economic endowment across population remains uneven (ABS, 2012). For instance, data from Australian Bureau of Statistics (ABS) indicate that one in five (20 per cent

or 1.7 million) households were in the category of low economic resources in 2009-10 (ABS 2012). A more disadvantaged situation exists in the regional and rural areas due to the lack of opportunities and infrastructure and access to the services. Official statistics from ABS show that people with non-school qualification decline with the increasing level of remoteness (ABS, 2008). Patients suffering from cancer in remote areas are up to three times more likely to die within five years of diagnosis than patients living in cities (National Rural Health Alliance Inc., 2012). A recent study shows that in many rural communities communication infrastructure are characterized by limited or lack of access to consistent and high-speed broadband internet and its poor coverage and broadband 'black spots' (ABS 2013a).

While the Government of Australia is implementing National Broadband Network (NBN) to provide high-speed broadband infrastructure in the rural and remote areas over the next ten years (DBCDE, 2011), it does not guarantee the usages and skills to use ICTs. Promoting the ICT diffusion and adoption is not only about the ICT infrastructure but also about supporting the ICT solutions and empowering local communities to use the technology (Broadbent and Papadopoulos, 2013). However, gaps exist in understanding the barriers to digital inclusion in Australia, especially in the regional economic development and intra-industry/sector context (Holloway, 2005). Earlier studies on digital divide in Australia mainly focused on small cities or towns (e.g., Atkinson *et al.*, 2008), and specific communities/programs (Black and Atkinson, 2007). There are some studies focusing on the digital divide between metropolitan and non-metropolitan areas (Simpson, 1999) or within metropolitan areas (Holloway, 2005). There is considerable gap of knowledge about the digital divide within a regional or local government context. Moreover, many of these studies are dated in the context of rapid deployment and use of digital technologies. This study provides perspectives in the broader regional context considering a case for the Southern Downs Region (SDR) in Queensland.

3. METHODOLOGY

3.1 Method

The research employed qualitative approach to answer the research questions. Qualitative methods include FGDs – these are group discussions organised to explore a specific set of issues (Kitzinger, 1994). In addition, the research also used a survey questionnaire to gain the demographics and participants' perceptions about digital technology. The FGDs assisted in understanding the issues, opportunities, challenges and barriers on the progression of digital future to identify and prioritise community preferences. The FGDs were conducted in two parts. In the first part a strengths-weaknesses-opportunities-threats (SWOT) approach was employed. A policy matrix focusing on access-affordability-application issues of digital technology was developed in the second part.

The focus group meetings were guided by a set of open-ended questions. Prior to the FGDs, the issues were discussed with the participants by a power point presentation. An experienced researcher facilitated the FGD as the moderator. Three FGDs were conducted concurrently. Each FGD was conducted for about 50 minutes.

3.2 Overview of the study area

SDR is a Local Government Area located in the Darling Downs region of Queensland, Australia, along the state's boundary with New South Wales. It was created in 2008 from a merger of the Shire of Warwick and the Shire of Stanthorpe. According to 2011 Census, the number of resident population in the Southern Downs Local Government Area was 33,883: 48.97 per cent were males and 51.03 per cent were females (ABS, 2013b). Of the total population in the SDR, 3.3 per cent were Indigenous persons, compared with 2.5 per cent

Indigenous persons in overall Australia. The median age of people in the region was 42 years, of which children aged 0-14 years made up 20.6 per cent of the population and people aged 65 years and over made up 19.1 per cent of the population. Of the total population, 26.4 per cent of the people were attending an educational institution in 2011 as compared to more than 30 per cent in Australia. More profoundly, the attendance rate in tertiary or technical institution in the SDR was only about 12 per cent as compared to about 21 per cent in Australia (ABS, 2013b).

The major industries of employment in this region include education, sheep, beef cattle and grain farming, cafes, restaurants and takeaway food services, meat and meat product manufacturing and road freight transport (ABS, 2013b). Improvement of the business diversity in the area as well as fostering economic growth and productivity in the information age remains a key regional agenda. It is expected that rollout of broadband Internet will play an important role in building the social and economic strength of the region.

4. ANALYSES AND DISCUSSIONS

4.1 Profile of the FGD participants

Focus groups can provide a range of ideas and perceptions of the participants. They also illuminate the differences in perspective among groups of individuals (Rabiee, 2004). The selection of the members of the group should, therefore, aim at feeling comfortable with each other to ensure their engagement in discussion (Krueger and Casey, 2000). Hence, each focus group comprised of 6-7 members at least over half of whom were female. The homogeneity was ensured in terms of broader occupation. The profession of the participants were based on various educational institutions: academic, health and business. The diversity of the participants was maintained in terms of age, occupation, educational level and income. A total of 20 participants attended the FGDs. Table 1 shows the demographic profile of the FGD participants. In terms of the use of the Internet service, it is found that about 55 per cent of the participants use the service of Telstra, followed by Exetel (10 per cent) and HaleNET (10 per cent). When asked about the satisfaction with the Internet service provider, over 47 per cent of the participants indicated their dissatisfaction about the quality of the service (Table 2). Figure 1 plots the participants' viewpoints regarding the quality of Internet service over the last three years. About half of the respondents observed that quality of the Internet service got worse or did not get better in the last three years.

4.2 Results from FGDs

4.2.1 General perception

FGDs were initiated by the moderator with the importance of the digital technologies in their day-to-day usages. Participants raised some vital points regarding digital technology. In their perceptions digital technology could help increase their academic knowledge by providing access to information and online resources. They opined that digital technologies enabled them to consult a medical practitioner or expert remotely. It not only saves their time and resource but also enhances their engagement with ongoing business activities and occupation. Most importantly they realised that the uses of digital technology offered them a chance to update their skills as a community and also helped them to accomplish their jobs more efficiently. Students acknowledged that they even did not need to go to libraries due to the availability of huge resources online. Older community members admitted that the use of digital technology had made their lives easier as they could perform their daily activities from home such as on-line shopping, knowledge gathering, networking and medical consultation.

Table 1: Demographic Profile of the FGD Participants

	Frequency	%	Cumulative %
Gender			
Male	7	35	35
Female	13	65	100
Occupation			
Government	9	45	45
Other Private	3	15	60
Medical	1	5	65
Agriculture	2	10	75
Volunteer	1	5	80
Student	2	10	90
Retired	1	5	95
Education	1	5	100
Education Level			
Secondary	4	20	21.1
Trade/certificate/diploma	7	35	57.9
Tertiary	8	40	100
Age group			
Below 20	2	10	10
21-30	3	15	25
31-40	3	15	40
41-50	5	25	65
51-60	4	20	85
More than 60	3	15	100
Household income level - gross per year			
$0-$41,599	3	15	18.8
$41,600- $103,999	8	40	68.8
$104,000- $149,999	3	15	87.5
$150,000 or more	2	10	100
Monthly spending on Internet ($)			
Less than $30	2	10	10
$30-$49	2	45	55
$50-$79	4	20	75
$80-$99	5	25	100

The participants identified positive role of digital technology for education and medical services:

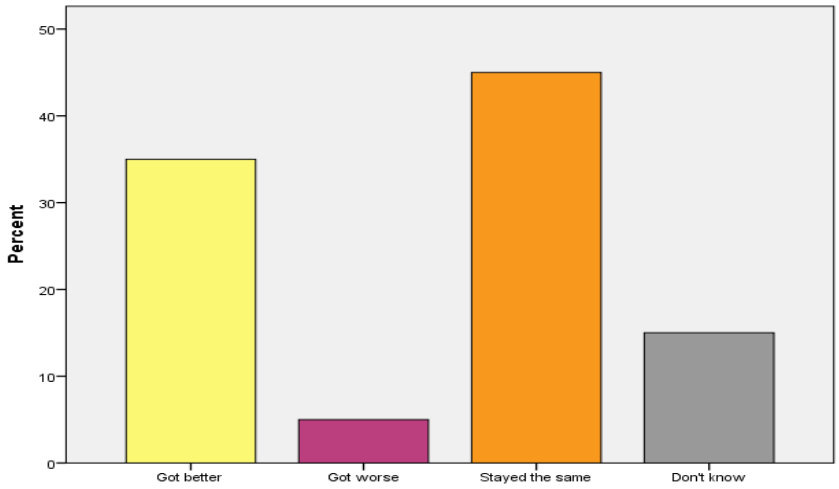
> "*The significance of using internet is extremely strong in schools and colleges. We can get information and increase our knowledge. It helps us do our assignments and achieving better outcomes.*"

> "*The role of digital technology is immense in hospital. Look, we can now communicate with medical experts online. We do not need to go to Brisbane to consult specialist doctors every time. It saves our time and money as we do not need to visit them in-person.*"

Table 2: Satisfied with the Speed of Broadband Connection

	Frequency	%	Valid %	Cumulative %
Highly satisfied	1	5.0	5.3	5.3
Satisfied	6	30.0	31.6	36.8
Neutral	3	15.0	15.8	52.6
Dissatisfied	4	20.0	21.1	73.7
Highly dissatisfied	5	25.0	26.3	100.0
Total	19	95.0	100.0	
Missing System	1	5.0		
Total	20	100.0		

Figure 1: Response to the Quality of Internet service



Overall, the community identified the use of digital technology to be cost-effective. In their daily economic activities, they are able to compare the price and quality which are reflected in their household budget expenditure. FGDs identified some internal strengths of the community to cope with the challenges of digital futures.

4.2.2 Internal Strengths

In response to the question "What advantages do your community have to exploit opportunities in the digital futures?" focus group participants identified several key advantages that are outlined in Table 3.

The FGDs participants were of the view that the local organisations such as the Chamber of Commerce, the Granite Belt Wine Tourism and the Wine College were well established, already had key strengths in the digital area and were working co-operatively. They are positioned to play a strategic role in the digital future of the region together with the regional council. They felt that the advantage of digital technology would help them create stronger community links with greater outreach to people and business groups.

Table 3: Internal Strengths of the Community

- Many business and agricultural enterprises already have Internet access through wireless network although service quality is not satisfactory
- Some small businesses have already started using Internet for service delivery
- Community is receptive to digital futures
- The mainstream business community is ready to adopt the new technology
- Local organisations such as the Chamber of Commerce, the Granite Belt Wine Tourism and the Wine College can be a powerful platform to promote the use of digital technology for the Stanthorpe community
- Each of these institutes already has key, unique strengths in the digital area and work co-operatively together and are positioned to play a strategic role in the digital future of the region
- Some local organizations are already providing online training programs
- A good skill base exists within the community as people from other places with IT skills have relocated to Stanthorpe because of tourism

4.2.3 Internal weaknesses

In response to the question "What weaknesses your community have that pose difficulties in exploring opportunities in the digital future?" participants opined that community's rural and remote locations were the main weaknesses for the digital age opportunities. Participants identified three major problems as impediments to digital usages. These were poor infrastructure, small population size and lack of required skills. Participants' responses were:

> "*Especially the older community members are scared to use computer. They lack digital skills and training. There is a knowledge gap to flow the information to the next generation too. Hence, some are unwilling and scared to allow their children to use the Internet.*"

> "*Use of digital technology is time-consuming as reading instruction takes more time. We [older people] don't have any training on the use of technology*."

Participants identified the speed of the Internet as slow due to the disconnection of optical fibres with the tower. They identified this infrastructure issue as the 'granite shell'. Besides, participants expressed their concern about the health issue of their children related to the overuse of Internet and video games. Moreover, one participant reacted as:

> "*Young generation is making friends through the Internet. They even do not know each other personally. This is making children socially inactive.*"

Participants also expressed their concern over forgery such as illegal use of credit card information; many small businesses believe they are immune to cyber threats. The participants were concerned that small businesses, particularly in agriculture and tourism, face challenges to get online and build a strategy that is profitable for their enterprises, as they do not have the knowledge, skills and understanding of the opportunities digital technology offers. The key points identified by the focus groups in regards to the internal weaknesses are summarized in Table 4.

Table 4: Internal Weaknesses

• Limited access to services in remote areas
• Lack of awareness about the risks as well as benefits of digital technologies
• High costs of running business including labour shortages and increasing utility charges and business taxes, rent and rates
• Lack of knowledge, skills and understanding of the opportunities digital technology offers.
• Lack of up-to-date marketing strategies
• Lack of willingness to change and embrace the new technology
• Lack of knowledge on how to use the technology
• Monopoly of some Internet providers creating fewer choices for customers
• High costs for the internet facility
• Uncertainty regarding the monetary return from further investment on ICT
• Some people still believe that ICT issues are too difficult to learn (e.g. older people)
• There are still some people in the community who are not interested to learn – negative attitude towards digital technology still persists
• Many people live in alternative style of life
• Many agricultural agents still do not use computer

4.2.4 External Opportunities

Regarding the question "In your opinion, what are the opportunities being created through the recent development and deployment of broadband services, particularly with the rollout of NBN in your locality?" participants expressed that digital future provided the opportunity to increase productivity, expanded their reach and generated new products and services (Table 5). In the local area, entrepreneurs can run their businesses with less labour. Many have embraced this shift and integrated it into their own business practices.

One participant reacted as:

> "*Local small business has the opportunity to sell their products outside the community due to easy access to technology. For example, iPod is reachable to them. They don't need enough marketing skills. Business has come to them on the street. That means iPods sell themselves*."

In tune with the above comment another participant opined:

> "*Rich web pages and information along with faster Internet connection poses the opportunity to run a business with minimum outlay to offer them an opportunity to be self-employed. These also provide them to find a supplier with minimum outlay.*"

The participants articulated that digital technology would have faster speed and greater reliability for improved logistics in terms of getting products to the markets and access to different regions that would generate more income. It will attract new skills and industry and encourage regional development through opening of new markets.

Overall, there is a consensus among participants that digital technology enhances the gross domestic product. The current contribution of this sector to GDP is 6.5 per cent. To substantiate their argument participants provided examples of the growing contribution of tele-health and e-learning to the economy. These save expenditures of the service recipients. Alternatively, young people can increase their skills by acquiring knowledge from cross-country and cross-nation providers.

Table 5: Opportunities

• Time saving and cost-effective
• Bigger advantage through internet banking
• Mining and hospitality tourism can reach a big audience and clientele
• Improved logistics in terms of getting products to the markets
• Access to different regions, labour force, greater marketing potential
• Opportunities for gaining new skills, more access to education
• Attract new skills and industry
• Increasing percentage of individuals with specialised internet/computer knowledge and skills
• Larger access to wholesale
• Larger customer base
• More access to education
• Easily accessible courses on hospitality

4.2.5 Barriers of ICT inclusion

In response to the question "What are threats for the inclusion of your community to digital future?" participants identified three major threats posed from digital future. First, the unemployment problem in the rural areas from losing small business opportunities is one of the major threats. Participants presume that local small business entrepreneurs are facing increasing competition now than before because of the global access of the consumers to on-line shopping. Customers and buyers are purchasing on-line from extended supply chains. Therefore, digital inclusion can help to extend supply chain, and regional businesses need to prepare for this. Currently, local businesses are not competitive enough to cope with big companies. This ultimately moves away local businesses and can intensify unemployment problem for rural communities. Furthermore, it increases the depression and other mental health issues among community members. Second, the health issue is another concern; the by-product of digital future could be the deterioration of the health situation of the children in the long run, especially of the younger generation as they spend extended time with the computer. One participant commented:

> "*Big issue is kid's attraction to the Internet and Facebook. These encourage them to stay at home and pose a threat to their health. Hence, ultimately these increase health expenditures of the community.*"

Third, participants assumed that despite some improvements of the Internet services, availability of the tele-health service is still very limited. They highlighted this issue in the way that in most cases patients face difficulties to consult a specialist doctor through a tele-health consultation due to limited supply. This ultimately needs patients to visit medical experts physically. Some participants also raised concern over the usefulness of the tele-health service. According to one participant:

"*Tele-health is not worthwhile at all. Rather, face-to-face interaction is always helpful.*"

Participants raised some other threats of digital future (Table 6). These include, first, the issue of multitasking, i.e., digital technologies making users intrusive and information overloaded, and difficult to concentrate and thus have increased their stress levels. Second, small businesses are finding it difficult to survive due to the rise of technology-enabled shopping for customers. For instance, one can do shopping 24 hours a day globally.

Table 6: Threats/Barriers of Digital Inclusion

- Lack of internet coverage in many places
- Big problem is to sit with computer – time constraint
- Internet speed is not good – difficulties to send information to agents using the Internet as often the speed is too slow
- Technology enabled barriers – competition from large scale farms
- Internet cost is too high for some people especially pensioners and low income groups
- Monopoly of one local provider – lack of competition
- Uncertainty remains regarding the actual implementation of NBN in this area
- Small businesses, particularly in agriculture and tourism, face challenges to get online and build a strategy that is profitable for their enterprises
- Affordability of the technology such as high costs incurred by users of the technology
- Competition is not local, rather global now
- Ageing population not being able to tackle with the contemporary technology and usage
- Low mobile broadband penetration
- Shortage of skills and workforce
- The timing of the infrastructure rollout as other communities will get the head start before Stanthorpe has the chance

5. CONCLUSIONS

The purpose of the study was to understand the community preferences on digital future in the regional Australia. This examines the strengths, weaknesses, opportunities and threats of the digital inclusion in the regional context. The methodology applied in this study includes FGDs along with a structured questionnaire survey among the participants.

The findings from the study demonstrate wide range of issues and concerns related to digital inclusion in this region. The FGD participants believe that the communities, in general, are

receptive to digital futures. Many small businesses have already started to use information technology and the mainstream business community is ready to adopt new technologies. Online training programs as provided by local organizations are already in place and the Stanthorpe community groups such as Chamber of Commerce, the Granite Belt Wine Tourism and the Wine College can play a strategic role in the digital future of the region. Participants in the FGDs identified poor infrastructure, dispersed population and lack of required skills as the main barriers of digital inclusion. A strong public-private linkage can potentially help to remove the barriers of digital inclusion, especially in the context of infrastructure provisioning and supportive measures. Specific focus should be given to the digital literacy of the disadvantaged and older people – not only because of the fact that they are lagging behind in respect of necessary skills to cope with the changes but also they can place supporting measures for the next generation.

Finally, several actions have come forward from the FGDs. The FGDs indicate that digital coverage need to be cost-effective and people with low socio-economic groups may require specific supportive measures. This is important to provide digital education at low or subsidised cost at remote locations. It is therefore important to have a comprehensive understanding of community needs, demand and barriers of adoption to come up with a digital economy strategy for the future. While the FGDs provide basic understanding on the broad range of issues, further analyses on the socio-economic and geographic factors (remoteness) that hinder digital inclusion for households and businesses is clearly warranted.

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Small Town Pioneers: Renegotiating Self in Seachange Workers

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ABSTRACT

Many people embarking upon a 'tree or sea change' fail to sustain their relocation due to economic limitation among other factors. This paper explores the social, environmental and economic challenges faced by workers who choose a "lifestyle migration" to places rich in nature but "lean" in industry. Narrative inquiry was employed in this study and involved 22 participants who had been living in the study site, the Noosa biosphere, Queensland, for at least five years at time of interview. The findings comprise 40 key themes, including creativity as essential in the sustainability of lifestyle migration. These findings have the potential to better inform individuals considering the move as well as informing social policies and practices.

1. INTRODUCTION

This paper explores the challenges of 'lifestyle migrants' or urban refugees who leave the city in search of a better life in a destination characterised by nature (Kargillis, 2011). It is based upon a narrative study of 22 working people who relocated to the Noosa biosphere, South East Queensland, and have managed to sustain their relocation for at least five years.

The research considers how economic, social and cultural challenges were overcome where typically, participants changed the way they worked and developed skills sets in order to survive, due to the limited work options available. Creativity and innovation were found to be crucial in this problem-solving endeavour.

The intrinsic value of the natural environment is explored for its influence to impact upon the self-reinvention of these 'small town pioneers', from both an empirical and theoretical perspective. It is argued that the reflexive construction resulting from these external factors encourages a pioneering spirit and the taking of risks along with adoption of a self-reliant approach towards work and community involvement, as these small town pioneers embrace the wild frontier without the familiar structures of urban society. There exists a strong and intrinsic community engagement value to this research for the urban community, where the findings could conceivable assist potential populations to make a better-informed decision in considering lifestyle migration.

Aspects of the research are relevant to regional Australia and international regional communities, whether they classify as 'lifestyle destinations' or otherwise, in relation to remote working practices, financial insufficiency and social issues stemming from space/ proximity. The research does not explore independently wealthy retirees but is firmly targeted towards the thousands of workers in Sydney, Melbourne and other major cities who ask the

question – How can I get out of here and survive? While much research has been done on lifestyle migration (Hoey, 2005, 2006; Osbaldiston, 2010; Ragusa, 2010; Benson and O'Reilly, 2009), mostly it addresses the reasons why people leave the urban context and relocate. This paper aims to address relevant professional issues pertaining to the sustainability of lifestyle migration, as well as exploring theoretical interests relevant to academia.

2. CONTEXT SETTING, METHODS AND ETHICAL CONSIDERATIONS

The site of the study is the Noosa biosphere, Queensland, Australia. The study aimed to identify how working lifestyle migrants managed to sustain their existence in a context that is characterised by nature and therefore limited in industry, where creativity was suspected and then proven to be instrumental in meeting the challenge. The research involved 22 participants, ranging in occupation, who were aged between 25-54; who had moved to the site at least five years prior, from a city background; and who were working, thus excluding those not needing or wanting employment. Sustained relocation of at least five years is the measure used in the study to indicate a successful relocation. Participants were recruited through media exposure, relying upon community members to accept the invitation. The response yielded enough participants for an in-depth qualitative study however representation was missing from the trades, representing the largest sector in the region, so I undertook social networking to attract these participants.

Participants were asked to tell their story of moving to the site and were then asked a standard set of prompts designed to address the two foundation questions:

1. How do lifestyle migrants reinvent themselves?
2. What factors contribute towards a sustainable relocation?

Interviews were approximately two hours each to sufficiently incorporate a comprehensive exploration within the study itself, as opposed to relying on comparative data (Yates, 2003). These stories revealed pertinent information that would not have been satisfactorily retrieved through a question and answer format. A process of narrative analysis was undertaken, involving a three level operation (Walker *et al*, 2008):

Level 1 – description, transcription, cross reference with participants;

Level 2 – analysis between participants to generate themes, and their points of tension;

Level 3 – critical and cultural analysis through identifying standard and divergent meanings; explore connections to broader cultural, historical, and political influences.

The researcher's personal interests were clearly separated from content expressed, particularly in regards to the recent councils' amalgamation. Further, conformity was adhered to through meticulous transcription of the recorded narratives by the researcher, the cross-referencing of content and context and through providing participants with the opportunity to review narratives and narrative summaries. Changes incorporating participants' edits were made.

Initially I struggled to explain the theoretical position of the research to participants as the academic context did not fit the dominant cultural paradigm of the site. However, through the narrative process I gained confirmation of the relevance of this project as participant responses strongly indicated understanding of the issues and awareness of their problem-solving towards them. An applied theoretical understanding was also indicated, as illustrated when auto specialist, John, implied that he practices transfer of learning to keep developing his business. Some well-educated participants clearly articulated processes within innovation theory, for example, which relate to their experiences of survival and prosperity. Therefore,

the framing of intellectual concepts is diverse within this research where narrative methodology and its theoretical principles have proven highly suitable to the investigation in enabling the level of interpretation required for thematic clarification and saturation to evolve.

The use of narrative allowed me to begin to understand the disequilibrium of participants, and their actions taken to establish equilibrium. According to MacIntyre, social life is a narrative and conceiving of it as an enacted narrative, where actions carry intention, provides insight (Czarniawska, 2004, p. 3). Furthermore, I believe narrative to be the most relevant methodology to the inquiry because of the manner in which my interest was sparked for this research. I identified with the following comment by Clandinin and Connelly (2000, p. 128) as I addressed my own disequilibrium in living in an urban environment and worked through a convoluted process, conscious of my own story, to achieve equilibrium: "…formalists begin with inquiry in theory, whereas narrative inquirers tend to begin with experience as lived and told in stories…". Clandinin and Connelly support the use of narrative for research such as this that attempts to track personal change – "We take for granted that people, at any point in time, are in a process of personal change and that from an educational point of view, it is important to be able to narrate the person in terms of the process" (idem, p. 30).

Following the narrative account, questions were directed to participants to probe for information which would potentially concede with the theory that change and sustainability of relocation relied upon innovation through risk taking and flexibility (Georgsdottir and Getz 2004). This largely proved to be the case. The knowledge claim in this research is therefore socially constructed, coming from an interpretive/ constructivist position where its goal was to rely on the participants' views of the problem in collaboration with the researcher's interpretation.

3. THE PARADIGM OF WORK

The paradigm of professionalism within the lifestyle migration context is itself an emergent phenomenon, representing a focal issue in the research. In lifestyle migration, work focus is more frequently characterised by the adaptability and/or multiplicity of skill and occupation (Hoey, 2005, 2006) than by cultural obedience to any one profession, as more often found in urban contexts. This is due to the limited employment opportunities and small population size of lifestyle migration destinations.

Where the term 'professional' in the urban context identifies a standard of work type, such as the Australian Bureau of Statistics category of 'professional services' (as distinct from trades), the lifestyle migration scenario houses those who multitask, change direction on a regular basis or pursue hobbies towards a business, as culturally dominant in the study site (Tan, 2000; Chhetri *et al*, 2009; Kargillis, 2012). These activities may sit within the professional services realm and/or elsewhere. Therefore the meaning of the word 'professional' changes with the transition into lifestyle migration.

Congruent with such a transition are themes of loss of status and the establishment of new parameters of status; anxiety and stress which accompany status issues and financial worries; innovation and creativity which develop to forge solutions towards such issues, at least in those who sustain their relocation; and cultural and social adjustments which align with a dominant theme of lifestyle and community over themes of work and profession (Böhm and Land, 2007). Yet money, along with the changing value of money, is a central point of consideration in the daily lives of participants.

It is the differences between lifestyle destinations and the functioning of urban centres, where the larger scale promotes categories of professions and markets, which illuminates the

categorical gaps in the lifestyle migration paradigm. This landscape is instead defined by a merging and overlapping of professions and markets. Participants in this research are in a continual process of renegotiating their existence. They include a spectrum of employees, self-employed, entrepreneurs, part-time, multiple job owners and casual employed, cross-industry.

4. IDENTITY AND A SEARCH FOR THE IDEAL

An exploration of reflexive identity theory (Chappell *et al*, 2003) in the context of lifestyle migration is central to the research. As such, notions of authenticity and the ideal self (Hoey, 2005; Osbaldiston, 2010) in pursuit of an ideal life are examined in relation to change, which occur in response to external factors. Relational identity is relevant to this exploration as the fate of lifestyle migrants typically involves a change in status and work when relocating from an urban context to the lifestyle destination. Losing one's former reputation as an 'urban professional' through lack of opportunity in the regions is one example of this. Identifying as an employee in an urban environment and then entering a state of self-employment in the lifestyle destination is a variation on this.

The research explores literature on lifestyle migration and voluntary simplicity (Hoey, 2005; Benson and O'Reilly, 2009; Osbaldiston, 2010; Ragusa, 2010; Hamilton and Mail, 2003; Chhetri *et al*, 2009) to position the relocation as intrinsically tied to identity development, reflexively through the ensuing challenges of the move. This lies in comparison with the symbolic act of creating a new self, as argued by Benson and O'Reilly, which represents values and ideals of authenticity (Hoey, 2005). Therefore, while the symbolism of relocation to a place is often involved in the decision to make a lifestyle migration, as confirmed in the findings, indicating that a level of change has already taken place, it is the ensuing negotiation of social, cultural and economic challenges which result in change for the majority of participants. Anecdotally, survivors of five years or more represent only one third of those within the demographic who attempt the relocation to this study particular site. The success rate is far lower in another Australian study where 90 per cent either planned to move on to another town, the coast, or return to the city within a five year timeframe (Brooks and Munro, 2009; Ragusa, 2011).

The study also compares the phenomenon of lifestyle migration and the search for the ideal on a cross-continental level between Australia, Britain and America where cultural disparities are revealed between the three. Post-industrial North American-derived culture promotes its corporate masses as increasingly dissatisfied with the world of work and its associated stress (Hoey, 2006). British research reveals that it is the lower level workers in its post-industrial hierarchical culture, rather than the upper hierarchical position holders, that suffer greater stress and dissatisfaction (CCSU, 2004). However other research describes British lifestyle migration as comprising relatively affluent individuals (Benson and O'Reilly, 2009) and so the role of stress and escape may be less significant in the phenomenon there. Potentially the 'stressed-out' lower levels endure the penalty of its endemic class-oriented culture. Australian research (Chhetri *et al*, 2009) shows an almost even split between 'blue collar' and 'white collar' workers in the lifestyle migration scenario. These discrepancies imply the influence of culture upon stress, upon the desire to escape and upon the ability to break free of social expectations.

5. CREATIVITY, SELF-EFFICACY AND EMOTIONAL INTELLIGENCE

The role of creativity and innovation in the lifestyle migration quest is central to the investigation and operates conjunctly with identity theory. In this research, the broad

theoretical field of creativity is restricted and defined around the Deleuzian (1990) concept of creativity as a process of 'becoming', while innovation theory (ANTA 2001) is employed to illustrate processes within this overarching process.

In making mechanical moves and experiments towards achieving the ideal life/ ideal self in the lifestyle migration quest, participants were led to change perspectives, question the dominance of power structures and challenge assumptions (de Bono, 1982, 1995). These actions represent key aspects of innovation methodology, as participants learnt a new lifestyle and became someone new, whether ideal or otherwise. As such, the research positions lifestyle migration as a creative act of self-reinvention, imperative for sustaining relocation.

Georgsdottir and Getz (2004) describe the value of flexibility in the becoming process, where the ability to switch between conceptual frameworks demonstrates a capacity for innovation. In this research, a creative problem solving was demonstrated by participants involving such flexibility in their becoming. Mostert (2007) suggests that our everyday environment is held responsible for facilitating or blocking flexibility where the ability to perceive coincidence, for example, is a result of flexibility of mind. Moultrie *et al*. (2007) support the notion that the organisational climate has a direct influence over a person's willingness to express their creativity through qualities of challenge, freedom, dynamism/liveliness, trust/openness, idea time, playfulness/humour, conflicts, idea support, debate and risk-taking and where the physical environment can also act as a catalyst for creativity via visual stimuli, social and cultural activity and branding. There is a rich correlation between these dimensions and the community involved in the study, where these themes are reflected. The socio-economic and cultural climate encourages risk taking; the illusion of freedom exists, often in the form of self-employment and access to natural assets; playfulness is present, such as with natural amenity activities; the challenge exists of sustaining relocation in an economically limited region; qualities of trust and openness are supported in a small community; a strong brand through tourism boasting the natural environment is paramount where potentially the local stimuli provide a source of inspiration; and the environment facilitates reflection and idea time.

It could be argued that the instability of society, particularly through the work force (Wren 2008), encourages innovation as a problem-solving endeavour, propelling the pursuit of lifestyle migration, or at least the belief that one can address the challenge. However, risk adversity is often the outcome when the challenges prove too great, as proclaimed by some participants and supported by statistical data (ABS, 2006a, 2006b) showing a high out-flux of working aged residents in the study site each year. The equation of risk versus capacity introduces the concept of self-efficacy (Bandura, 1977, 2006) and realistic self-assessment, along with emotional intelligence (Goleman, 1998), which are shown in the research to influence participants' ability to sustain their relocation. It is within this context that self-efficacy and emotional intelligence are discussed in attempting to understand how individuals resolve the problems of uncertainty and insecurity through lifestyle migration.

Bandura explores perceived efficacy to influence the types of environments people choose and the direction of their personal development where "Social influences operating in selected environments continue to promote certain competencies, values and interests…" (Bandura, 2001, p.10). Therefore a breaking away of former social influences towards an ideal enables new aspirations to develop, playing an important role in identity development and becoming someone new. Escalating self-efficacy was highly recognizable in the narratives of the majority of participants through the development of innovation and adaptation to a new social infrastructure, involving new ways of being and relating, particularly around negotiating sustainable employment.

Daniel Goleman's (2006) theory of emotional intelligence further reiterates the significance of self-efficacy through his definition of the interrelating qualities between the two, where self-awareness, involving realistic self-assessment, is a common element along with self-regulation. Other elements of emotional intelligence which illuminate the lifestyle migration quest include openness to change, which belongs with self-regulation, and reflects the skill of flexibility, discussed previously. Goleman's definition of motivation is also relevant, involving a passion for reasons that go beyond money or status as well as a propensity to pursue goals with energy and persistence (Goleman, 1998) – such is the quest of lifestyle migration.

One could argue that lifestyle migrants are ubiquitously self-aware at the time of making their departure from the city, in reflecting on Goleman's thoughts where a highly self-aware person will stay focused on their direction and so can refuse a tempting financial offer for instance that is not aligned with their principles or long-term goals. By contrast, a person lacking self-awareness will make decisions which create "inner turmoil by treading on buried values" (Goleman, 1998, p. 96). Indeed, the inner values of lifestyle migrants often bring external turmoil, heightening risk in the pursuit of new values over a scenario of sameness. However, as realistic self-assessment, along with self-efficacy, is the primary feature of self-awareness, it is proposed that this group are less likely to 'fail'. The potential exists that many 'failed' lifestyle migrants do not possess a developed self-awareness.

In becoming therefore, innovation is integral to the transformation and essential in the renegotiation of sustaining the relocation. In line with this, self-efficacy and emotional intelligence are crucial in managing the challenges of the negotiation, where successfully pioneering the path in learning this new lifestyle occurs in tandem with the development of these two skills.

6. THEORY AND PRACTICE

This is a study which addresses a community of interest defined by the issues explored. Typical participant comments included, "It's the first thing people in the city ask you – how do you make a living up there?" and "Yeah, everyone talks about the difficulty in earning money, it's a daily conversation."

Participants represented the variety of small town pioneers to be found in the study site and other similar scenarios around Australia, from builders to tourism operators, graphic designers to internationally successful entrepreneurs and a local councillor. These are the 'every man' and 'every woman' in the community, some of whom were unenthused to explore the topic in an academic setting, but readily discussed the issues in a colloquial setting. Participants however acknowledged the relevance and understanding of theoretical concepts. For instance, while creativity is a theoretical paradigm it is also highly applicable in the professional sphere. Where participants did not generally consider themselves creative, they understood the relevance of creativity and innovation to their narratives, their transformation and their survival.

The research considers the motives for participant relocation as instrumental in determining a level of ensuing change, per participant, over the length of their migration. To do this, a scale of change was proposed based upon the following criteria:

1 = minimal acknowledgement of change due to circumstances of relocation.

2 = relocation introduces change by allowing 'breathing space' for self-directed change.

3 = relocation introduces change through reaction to external influences.

4 = relocation introduces change through reaction to dramatic external influences.

All participants demonstrated flexibility and innovation and all but two demonstrated significant identity development in relation to this. In the few instances where my interpretation differed from the participant I noted the contradiction.

Data was analysed using Morse's Three Level Operation (Walker *et al*, 2008), where themes were generated both within each narrative and across the narratives collectively in an aim to determine patterns of experience. These themes were then refined to establish a list of 30 key themes which represented primary areas for exploration. These were housed within the following categories: place, work, community, economic, mental/emotional. The primary themes were 'unpacked' through exploring a range of perspectives which presented through the narratives, such as investigating how participants interpreted the theme of risk, for example. From there, conclusions could be drawn in regards to the themes and their implications.

Several themes encountered through the theoretical investigation of the research translated directly to the experience of participants. The priority value discerned through the narratives was attainment of Control Over One's Own Life, which shares commonality with Chhertri *et al*'s study of Downshifting in South East Queensland (2009). It was comprised of several sub-themes pertaining to culture, work and society. The natural environment was the most frequently cited value but rated second in priority.

However a host of contradicting participant experiences were also revealed through these themes and so the grand narrative of the study, which I had intended to produce, became an impossible task as such binary oppositions position meaning as defined against what it is not (Smith and Doherty, 1996 and Derrida, 1967). To resolve this quandary, I employed Lyotard's localised narrative (1979) as crucially relevant to the research. Issues pertaining to community, the value of money, simplicity practice, power and authority, status, the environment in the context of extrinsic stimulation or lack thereof, and lifestyle each carried conflicting interpretations. The study determined 40 key findings that presented through the research within this divergent framework, in lieu of a grand narrative.

7. THEORY AND PRACTICE – THE FINDINGS

The 40 key findings from this study can be broadly categorised into three groups: socio-cultural transition; socio-economic context; and the physical environment, though many overlap. Below is a selection of the most commonly expressed findings.

Socio-Cultural Transition: Socially, themes of status and community posed a diverse spectrum of challenges and change agents for newcomers. For example, status was found to be fluid due to the unstable economy where one cannot judge others' status, according to several participants. The small population of this lifestyle migration destination has resounding implications upon status. One extreme revealed that the prevalence of small business in the study site counters paradigms of hierarchy, which again is related to status, where for some participants, common values such as the natural environment helped to dissolve status barriers because "next to the sea we are all the same" (Alexander). However other views revealed that the wealthy are highly visible, creating angst within community. Mostly participants agreed that the diverse range of economic levels in the study site did not inhibit interaction and cohesion where comments such as, "I don't know anywhere else where you've got billionaires drinking with cleaners," were common (Steve).

Other findings within this category include:

- Innovation is supported because of the comparative absence of governing power structures that would otherwise limit personal empowerment;
- Passionate pursuits, for example, hobby to business, can be explored more easily when money is not the primary aim and in an environment where people readily discuss their aspirations;
- Gaining a feeling of control over one's life is a key value of the area and this is not generally focused on money;
- Community integration and a feeling of belonging is more likely to help lifestyle migrants stay in the area;
- The power of the press is socially stronger in a small community than a city;
- Lifestyle migrants need to be proactive in making connections and friendships within the community;
- Many new residents embark on voluntary work to make social connections;
- Community creates its own fun in a place where there is more privately owned space and less administered entertainment;
- Aspects of life such as work, hobbies and home are intensely interconnected creating a strong sense of continuity in a small town, compared to a city where life is compartmentalised;
- Continuity within a small scale community supports the impression of a more unified relational identity compared to a city where multiple identities are required for separate factions of life.

Socio-Economic Context: It was determined that the small population of the scenario also directly affects livelihoods where networking and reputation management were found to be crucial. This in turn impacts upon the reprioritisation of participants' urban-culture-based values, where community spirit for example is heightened as a survival mechanism. Alongside the renegotiation of cultural values and behaviours is the development of innovation in the problem-solving of economic and other challenges.

As suggested, lifestyle migrants need to apply creativity in order to survive where integral to this survival is innovation and flexibility. Financial need, the absence of environmental stressors and the natural environment are some of the factors identified in the empirical work which promote these qualities. The enhancement of creativity and innovation were shown in participants who were consumer-oriented and also those for whom lifestyle migration has encouraged values of simplicity. In addition, a driving force of passion over cognitive motivation was identified as inherent in the culture that these small town pioneers had created, in contrast to corporate culture where personal goals are often "kept secret" (Karen). The leading role of passion follows on logically from the inception of lifestyle migration, which was originally termed 'non-economic migration' (Hoey, 2005, p. 590), shifting the focus from the tradition of relocating for work to relocating for desire.

Some other findings in relation to the socio-economic context include:

- Multi-tasking and/or flexibility are necessary survival skills;
- Innovation is encouraged because of the variety of work activities and knowledge within a small population that inspire cross fertilisation and transfer of ideas;

- Lifestyle migrants need to establish their own careers/source of income rather than expecting an appropriate job opportunity to be offered;
- Remote working arrangements still require interpersonal contact, reliable technology and budgetary allowances in order to be viable;
- Remote workers run the risk of isolation if they are not proactive in creating networks within the community;
- Remote working practice presents a moral issue regarding economic engagement with the local community;
- Lifestyle migrants need to accept work below their skill level or volunteer to make connections and encounter better opportunities;
- Risk taking is a reality for many lifestyle migrants where good risk management skills are important for sustaining relocation;
- The meaning of success is more closely related to growing self-efficacy rather than money, due to the fluid and unstable economy;
- The learning that takes place largely regards the development of economic and social survival skills with corresponding self-efficacy.

The Physical Environment as a Change Agent: The impact of the physical environment upon identity, in relation to the search for meaning, was raised in the narratives where arguably, lifestyle migration is a response to a growing sense of anonymity within urban culture (Matchan, 1999). Recognition of the collective cultural impact upon the landscape (Greider and Garkovich, 1994) was expressed where the lifestyle migration community, despite an obvious lack of homogeny, shared communal values which position the natural environment as a priority.

The impact of the beauty of the physical environment is theoretically explored in relation to creativity and innovation (Crawford *et al*, 1992; Mitchell *et al*, 2004; Kristensen, 2004; Moultrie *et al*, 2007) as well as empirically explored where the research positions the framing of the environment as integral to the development of creativity for the majority of participants. Further, the binary of consumerism/simplicity was explored in relation to the natural environment where money had become either less important, due to the struggle in attaining it, whilst simultaneously increasing appreciation for the environment; or where money had become more important, solely due to the difficulties surrounding it. Following on from this, the level of stress and wellbeing were again explored theoretically and empirically in posing the question – How effective is the natural environment in abating financial worry? The answer formed contrary responses reflected by the consumerism/ simplicity binary.

The natural environment was mentioned most frequently by participants and presented as a key value which underpins the socio-cultural and socio-economic paradigms.

8. CONCLUSION

As demonstrated, this research on lifestyle migration is grounded in lifelong learning principles, in the context of broader social change. The concept of self-actualisation (Rogers, 1980) is interrelated with the lifestyle migration quest as it involves self-awareness, personal growth and the fulfilment of potential above concern for the opinions of others, among its actants. As such, the quest for self-actualisation forms the pinnacle of Maslow's famed Hierarchy of Needs (1962). However, where working lifestyle migrants take the risks to relocate to unknown landscapes of limited opportunities, their search for a new and better life

more often involves a plummeting to the base of that pyramid as they change environmental, social and economic paradigms in the process. As show in the research, in order to reach self-actualisation they must then ascend through the levels of physiological, safety, love and belonging and esteem needs, according to Maslow, before the peak of the pyramid can reveal itself. This quest is what the research has explored.

Here I have outlined the key conceptual elements of the study and have addressed its theoretical and methodological proposition. Its contribution comprises:

1. Presenting findings which governing authorities may incorporate to inform their socio-cultural-economic decisions;
2. Presenting an opportunity for transfer of learning through narrative analysis in exposing limiting and facilitating factors involved in lifestyle migration on a personal and relational level – socially, culturally and economically;
3. Combining traditionally disparate concepts – creativity theory and identity theory – to understand the problem of the sustainability of lifestyle migration among working people.

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Regions that Work Together: Cross-Regional Responses to Resource Sector Growth in Queensland

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ABSTRACT

Development of the resource sector is a key driver for growth at the regional, state and national levels. However, cumulative development can place pressure on the sustainability of local communities. This study explores appropriate responses to resource sector development in regional Queensland. The work focusses on 'cross-regionalism', through a case study examination of the Fitzroy Central West, Mackay Isaac Whitsunday and Wide Bay Burnett regions. Challenges and opportunities are discussed across ten regional development themes; and cross-regional responses are described under the categories of policy development; investment; leadership and innovation; research and evaluation; education and engagement; and on-ground initiatives. The study demonstrates that attention to liveability, family and social wellbeing; transport and development infrastructure; and workforce planning, skills and education is critical, and that a mix of options is needed to help regional communities manage cumulative impacts. It also points to a growing role for cross-regionalism as a variation of the place-based approach to regional development, affording regional communities the ability to better test ideas, attract investment and influence regional policy-setting.

1. INTRODUCTION

Resource development and regional communities in Australia

In Australia, the performance of the resource sector in is a key driver for growth at the regional, state and national levels. The resources sector includes a range of extraction, processing and transport operations, including coal and minerals extraction; coal seam gas and liquefied natural gas production; coal- and renewables-based power generation and ports, as well as the construction activities associated with the development of these sites. In the past decade, strong demand from the developing Chinese and Indian economies has driven high growth rates in the resources sector; yet the global financial crisis and European debt crisis have resulted in a slowdown because of the historically high Australian dollar (BREE, 2012a). The latest forecast suggests a softened outlook for the Australian resources sector in 2012-13, with increased export volumes but decreased total value overall (BREE, 2012b).

The resource sector is a powerful driver of change in Australian regional centres, including those that are hosting extractive activity as well as those that do not. The scale and nature of most recent mining boom has caused a fundamental shift in how the fortunes of the resource sector are tied to regional prosperity, as well as to that of Australian society more broadly (Measham *et al*, 2013; Carrington and Pereira, 2011). The cyclical growth patterns of the

resource sector pose a difficult conundrum for regional centres: when the sector is performing highly and driving rapid growth, it provides strong opportunities for regional economic development; yet it simultaneously puts pressure on local communities' economies, environment and social wellbeing (Commonwealth of Australia, 2013; Haslam McKenzie, 2013; Petkova-Timmer *et al*, 2010). Sudden declines in activity also leave regional communities vulnerable to negative economic and social consequences. A third issue is cumulative impacts, which result from 'the successive, incremental and combined impacts of one, or more, activities on society, the economy and the environment' (Franks et al., 2010:10). The cumulative effects of resource extraction activity on regional centres in Australia are well reported anecdotally, and examples are also increasing in the published literature (Brueckner *et al*, 2013; Measham *et al*, 2013; Porter *et al*, 2013). To date, most research work in the cumulative impact areas has concentrated on defining and measure the impacts, with studies on management options often being focussed on (cumulative) impact assessment tools (e.g. Haines *et al*, 2013; Moran *et al*, 2013). However, there are also a number of studies emerging that have examined how to address cumulative impact issues from the perspective of collaborative and local responses.

Responding to cumulative effects using collaborative and cross-regional approaches

The complexity and interlinked nature of cumulative impacts, as well as the shared responsibility for their creation, necessarily means that a range of actors are involved in managing and mitigating adverse effects (Porter *et al*, 2013). Given this, collaboration is highly likely to contribute to building successful responses. Porter *et al*. (2013) has profiled some thirty Australian examples whereby cumulative impacts from the resources sector are being addressed through collaboration at a range of spatial scales. They concluded that collaboration can create more efficient resource allocation, foster innovation and creativity, and facilitate coordinated long-term solutions. Meanwhile, McDonald *et al*. (2013) examined collective efficacy and how place-based partnerships can influence resource allocation; their work subsequently showed that developing strong networks amongst stakeholders can strengthen political and social capital, in turn focussing investment into regional competitive advantage. However, the study by McDonald *et al*. did not specifically report on the value of cross-regionalism within those networks, being focussed instead on the internal dynamics of an individual region.

Measuring the meaning, function and value of cross-regional networks, as well as how these might be supported through policy frameworks, remains an area ripe for further research. For example, 'cross-border' policy is already being used in European settings to help balance regional competitiveness (Luukkonen and Moilanen, 2012). However, this practice has developed from convergence theory which is directed at addressing disparities between regions, rather than notions about regions with similar (economic) profiles working together for mutual benefit. The latter thinking is more closely aligned with the development of regional innovation systems, which are widely regarded as essential to unlocking the benefits of the knowledge economy (Lundquist and Trippl, 2013). Fazio and Lavecchia (2013) have also illustrated the importance of social capital and trust in regional development, observing that these are key determinants of economic growth that can be bolstered through clustering or agglomeration-like practices. However, most existing work on cross-regional working practices is limited to European or American contexts, where the interpretation of 'regional' is often quite different to that used in Australia.

A role for cross-regionalism via Regional Development Australia?

Regional Development Australia (RDA) is a partnership between the Australian, state and local governments to support the growth and development of Australia's regions. The formal roles of all RDAs are to:

- consult and engage with communities;
- promote and participate in regional programs and initiatives;
- provide information and advice on their region to all levels of government; and
- support informed regional planning (DIRD, 2013).

Recent work by Buultjens *et al*. (2012) has identified that RDAs have struggled to resolve their roles in their regions, including the resourcing implications of these. This situation has made it difficult for them to establish authority, be drivers of regional leadership, and to respond effectively to community expectations. One way in which RDAs role may be more effectively discharged is through developing strong inter-regional linkages, as these are critical to regional innovation and developing social capital for regional development. Buultjens *et al*. (2012) has already reported that RDAs are interested in pursuing policies and funding options to incentivise cross-regional RDA activities.

The objectives of this study were to identify the issues relating to cumulative resource sector development in regional Queensland, and to explore possible solutions via cross-regional or 'clustered' RDA efforts. Section two of this paper provides a brief description of the research methodology, followed in section three by a summary of the results obtained from the stakeholder consultation exercise. The discussion in section four examines these findings firstly from the practical perspective of assisting RDAs to recognise and pursue opportunities for cross-regional initiatives; and secondly, considering the theoretical and/or philosophical considerations about the role of 'cross-regionalism' in advancing regional development, especially in Australia.

2. METHODS

A participatory action research (PAR) project was used to collect qualitative information across a Central Queensland case study area. PAR methodology involves both the researcher and the project stakeholders being actively involved in formulating the research question(s) as well as in data collection and analyses (Bolden and Bagnall, 2009). The target communities were those within the Regional Development Australia boundaries for the Mackay Isaac Whitsunday (MIW), Fitzroy and Central West (FCW) and Wide Bay Burnett (WBB) regions (Figure 1). The research was pursued in three phases, namely:

1. a desktop review to synthesize information on the impacts of rapid development in the resource sector, especially those that are cumulative and cross-regional in nature;
2. the development and deployment of an online survey instrument; and
3. data analysis and identification of specific (cross-regional) action areas for RDA to pursue.

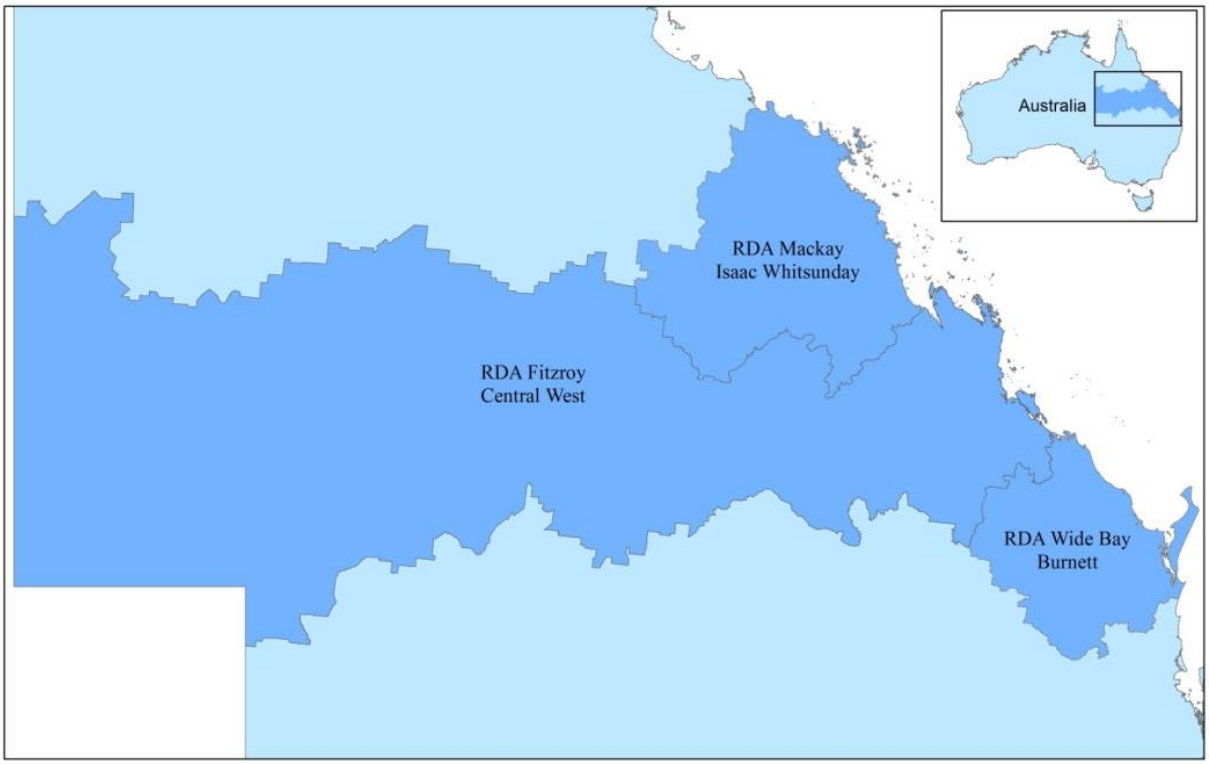
This paper reports on the data collected through the online survey and the action areas that were subsequently identified for a proposed RDA 'resource-regions' cluster.

The survey development was informed by the desktop review, which drew upon publicly available information sourced from academic, community, industry and government studies; including submissions to the Parliamentary Inquiry on fly-in, fly-out (FIFO) workforce

practices (Commonwealth of Australia, 2013). From these data, a series of ten regional development themes emerged:

1. Demographic and labour force shifts
2. Regional governance
3. Liveability, family and social wellbeing
4. Cultural aspects
5. Housing
6. Public health
7. Workforce planning, skills and education
8. Transport and development infrastructure
9. Water and energy
10. Environment and natural resource management

Figure 1: The Case Study Area, Comprising Three RDA Boundaries Containing Regional Communities Servicing the Resource Sector



The online survey instrument was then based on these themes with the objective of collecting information about perceptions and experiences of the impacts of resource sector development; regional priority areas of concern and suggestions for cross-regional solutions. The survey contained a mix of choice and open-ended responses, and was deployed under clearance from the CQUniversity Human Research Ethics Committee (certificate #H12/08-171). In late 2012,

the survey link was distributed to over 300 key regional stakeholders across regions of MIW (n=122), FCW (n=120) and WBB (n=90), using the professional networks of the RDA executive officers. Care was taken to ensure that stakeholders from across all industry sectors and community interests were approached. The survey was open for participation for approximately three weeks from 15 October through 4 November 2012. Data were analysed qualitatively using thematic discourse analysis, a flexible method to identify, analyse and report patterns within data (Braun & Clark, 2006). Following this, a series of action-points were developed for (and by) the participating RDAs, being mindful of the common issues shared by all three regions, as well as their individual and unique circumstances.

3. RESULTS

In the desktop review, a range of impacts across the environmental, social and economic domains were associated with resource sector activity in the case study area. However, it was evident that there is a lack of empirical data about the precise nature and extent of many of these impacts; and many issues appeared interlinked. This lack of data and understanding has already been acknowledged as a key barrier in terms of formulating regional responses (either policy and/or on-ground programs) (Commonwealth of Australia, 2013). The impacts reported were predominantly negative ones; however, this may reflect the reality that most research studies and regional planning initiatives are focussed on identifying challenges rather than reporting on positive situations. (Rare) examples of positive impacts included regional population growth, stimulation of regional supply chains and employment creation. Overall, much less information was available about possible impacts on the Wide-Bay Burnett region compared with its northern neighbours: this likely reflects WBB's recent entry to the resource sector economy, largely through mobile workforce provision.

Respondent profile

A total of 108 respondents participated in the survey (a response rate of approximately 30 per cent) with 90 respondents working through to the end of the questionnaire (a completion rate of > 83 per cent). Representation was mostly even across the studied regions, with MIW accounting for 36 per cent of responses, FCW 26 per cent and WBB 23 per cent; with a further 15 per cent of respondents not indicating their region. There was good representation of government (33 per cent), community (24 per cent) and industry (21 per cent) participants, with a further 10 per cent being peak representative groups (i.e., community or industry). Of the 19 responses received from industry, the mining, manufacturing and administrative services sectors accounted for almost half of the participants. The survey failed to attract participation form some of the key contributors to the regional economies, such as the construction and transport industries.

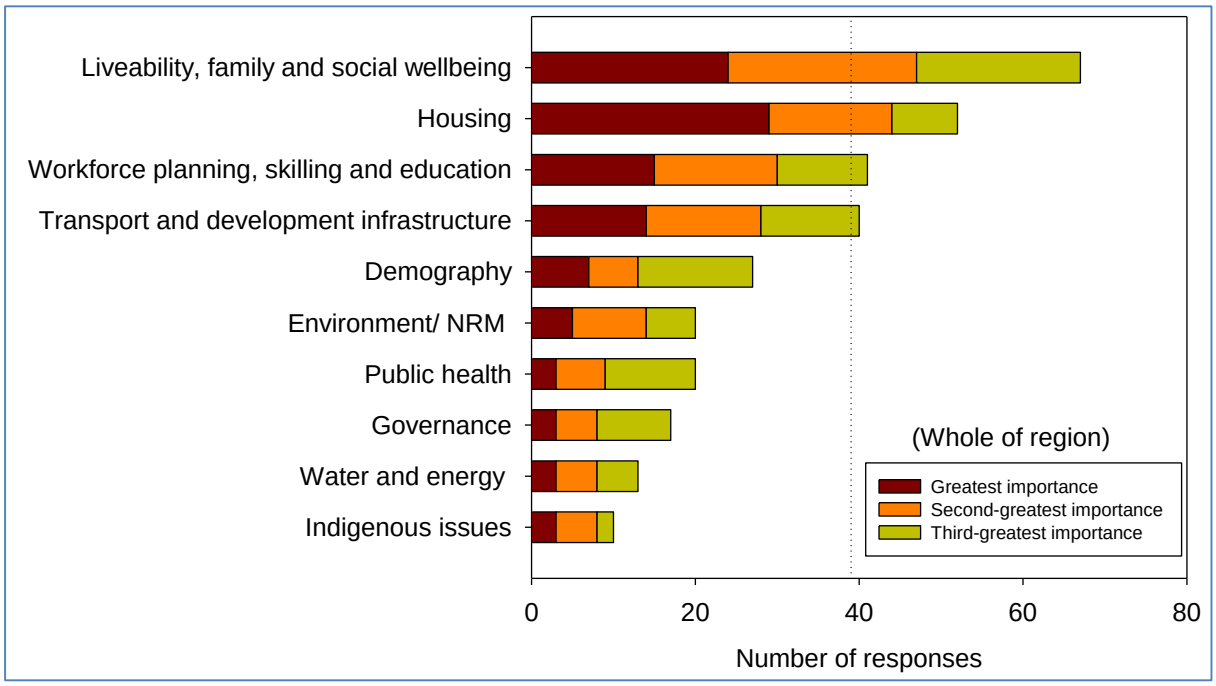
Priority areas for addressing cumulative impacts

The areas of liveability/wellbeing; housing; transport and development infrastructure and workforce planning were consistently rated as priority issues across the three regions (Figure 2). Areas of least priority included Indigenous issues, governance, and water and energy supply. The overlap across many themes must be acknowledged; for example, many stakeholders noted that cumulative impacts across infrastructure, health and housing each combined to create poor outcomes in terms of overall liveability. Some variation in theme prioritization was observed amongst the studied regions:

- in the MIW region, stakeholders placed greatest emphasis on liveability, housing and transport & development infrastructure, with Indigenous issues being ranked of least importance;

- in the FCW region, a similar sequence was observed, with the areas of greatest importance being housing, liveability and transport; and
- in the WBB region, liveability issues scored highly, followed by workforce planning, then transport infrastructure.

Figure 2: The Level of Importance Given to Each of Ten Regional Development Areas by Stakeholders (MIW, FCW and WBB Regions Combined)



Note: Themes scoring to the right of the dotted reference line were later designated as 'priority themes' for the RDA cluster.

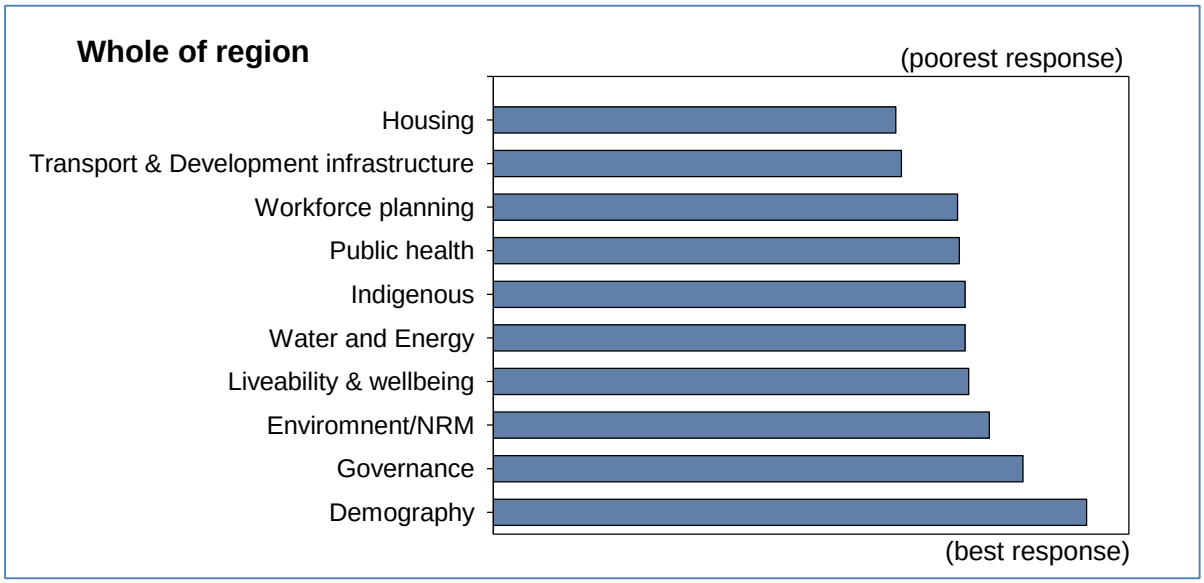
Perceptions about current regional performance

Respondents were asked how they felt their region was currently performing across the ten theme areas. Overall, participants indicated that performance was best in the areas of environment, governance and demography; and worst in dealing with issues related to housing, transport and development infrastructure and workforce planning (Figure 3). This supports the results captured elsewhere in the survey, in that respondents consistently gave priority ranking to those areas in which they reported poor current performance. A notable exception was in the areas of public health and Indigenous issues, which were rarely selected as 'priority issues', despite many respondents indicating that the current response for these particular issues was poor. Disaggregation of the results by RDA region again illustrated divergence in the way that stakeholders reflected on the issues:

- in MIW, respondents felt that Indigenous and water/energy issues were being handled less effectively; whereas responses around workforce planning issues were being reasonably well managed;

- for FCW, the areas of poorest performance included transport, housing and water; and respondents indicated a good deal of uncertainty around whether demographic planning issues were being handled appropriately; and
- participants in WBB indicated that the areas of poorest regional performance were transport, housing and public health; whilst performance was comparatively good in Indigenous issues, environment/natural resource management concerns and demography.

Figure 3: Participants' Perceptions about the Current Performance of the MIW, FCW and WBB Regions (All RDA Areas Combined) in Responding to Issues Related to Resource Sector Growth



Opinions on dealing with regional impacts

Participants were provided with a number of statements about regional development, collaboration, and the influence of resource development activities on their community. Stakeholders appeared to agree that collaboration was of high value; and that business participation was important in further dialogue and/or solution seeking about regional impacts (Figure 4). Meanwhile, respondents disagreed that 'investment in infrastructure is the best way to solve impacts', possibly in the context that other options, or a mixture of options may instead be preferable (Figure 4). The greatest uncertainty (as indicated by the number of 'don't know' responses) tended to occur around whether the respondent's own organisation would be willing to commit effort and/or resources to help address impacts; as well as the role of RDA in helping communities to address impacts (where almost 10% of participants selected 'don't know').

Preferences about the nature of a cross-regional response

Participants were asked to indicate the type(s) of response(s) they felt would be most valuable in addressing each of the ten impact areas, with more than one approach being allowable in each theme. A mix of actions by RDA was supported (Table 1). The most popular options included on-ground activities in the areas of public health, liveability and housing; and investment in the areas of infrastructure, Indigenous issues and water and energy. The focus on infrastructure issues is interesting given that it conflicts with the outcomes of Figure 4,

where respondents disagreed with the idea of 'investment in infrastructure being the best way to solve impacts'. The particular kinds of infrastructure spend called for by the stakeholders was also of note: this included a focus on transport, Indigenous and water/energy assets. This appears conflicted with historical data on applications submitted to the Regional Development Australia Fund (RDAF), a key channel for the Labor government's investment in the infrastructure needs of regional Australia.

Figure 4: Summary Results for Participants' Opinions about Key Statements Relating to Cumulative and Cross-Regional Impacts Related to Growth of the Resource Sector in the MIW, FCW and WBB Regions

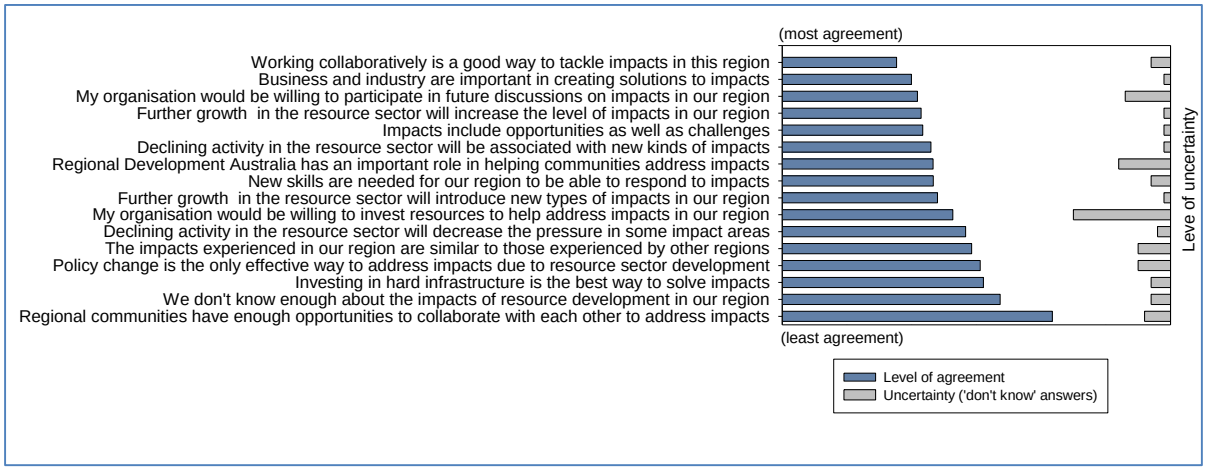


Table 1: The Preferred Nature for Regional Development Responses, Including the Top Three Theme Areas in which Particular Types of Responses should be Initiated, as Indicated by Participants. Results Represent the MIW, FCW and WBB Regions Combined.

Response type	Priority areas for focusing the response
On-ground activities (20.5% of responses)	Public health Liveability, family and social wellbeing Housing
Investment in infrastructure (19.6% of responses)	Transport and development infrastructure Indigenous issues Water and energy assets
More research (15.3 of responses)	Transport and development infrastructure Workforce planning, skills and education Public health
Increased access to information (15.0% of responses)	Regional governance Workforce planning, skills and education Indigenous issues
New or changed policy (14.7% of responses)	Workforce planning, skills and education Liveability, family and social wellbeing Water and energy assets
Stakeholder workshops (14.7% of responses)	Workforce planning, skills and education Transport and development infrastructure Housing

Exploring this issue further, a review of the submissions lodged in each of the RDA regions since the introduction of RDAF shows a clear trend for proposals in the areas of liveability (Table 2). On the one hand, this agrees with the survey results whereby stakeholders consistently rated liveability issues as being of high priority. However, comparatively fewer applications have been received in the areas of economic development, water and roads, and only three have been specifically related to Indigenous issues. This suggests a possible disconnect between the public's perception of the intent of the RDAF programme compared with the desired infrastructure needs of regional communities; or potential flaws in the applications process whereby high-priority initiatives (from the stakeholder's perspective) do not survive the expression of interest process leading to a full application. More complex factors may also be a play, such as a lack of capacity in existing regional organisations, which could contribute to fewer applications in otherwise high-priority areas.

Table 2: Nature of Project Proposals (Expressions of Interest) Lodged under RDAF Rounds 1-4 (2010-12), for the Three Studied RDA Regions.

	Mackay Isaac Whitsunday	**Fitzroy Central West**	**Wide Bay Burnett**
Liveability	5 (playground/child care/sporting and/or cultural facilities)	32 (daycare, sporting facilities, community facilities)	5 (community services hub, leisure facility, lifestyle facility, civic centre, neighbourhood centre)
Transport	2 (road/bridge upgrades)	4 (roads, aviation)	4 (aviation, car parking, railway)
Housing	1	1 (youth housing)	
Indigenous^	-	2 (information centre, water infrastructure)	1 (cultural centre, sewerage treatment, town revitalisation)
Public Health	2 (hospital, aged care)	1 (aged care)	3 (aged care, patient/GP accommodation, respite centre)
Economic Development	3 (town revitalisation, events)	1 (tourism)	5 (forestry, tourism/ events, town revitalisation)
Environment	-	1 (waste management)	1 (conservation/ protection)
Water and Energy	-	4 (municipal water treatment & water supply)	2 (sewerage facilities)

Notes: Proponents and specific project details have been withheld for confidentiality reasons. Submitted projects may have been listed under more than one thematic area.

^ Defined either as those that involved Indigenous culture (e.g. Indigenous tourism), or that were lodged by/within Aboriginal Shires.

The least support was indicated for policy change and/or stakeholder workshops: however, this contrasts with responses collected in the later stages of the survey, which were heavily populated by ideas about policy change being a key solution to many regional challenges.

In a separate question, participants were also asked to record their expectations about the specific role(s) for RDA in the region. Here, respondents favoured communication, engagement and collaboration as the key role for RDA, combined with advocacy for the region to increase success in Australian and State government investment programs. Many respondents also indicated concerns about visibility and resourcing of RDA and the need to clarify its roles, responsibilities and capabilities (data not shown).

Identifying cross-regional solutions and RDA actions

For each of the priority themes had been identified by stakeholders, the participants were asked to describe the problems they experienced in this areas as well as possible solution(s) for these, using an open-ended format. This yielded a rich source of information about the challenges and opportunities across the three regions. Stakeholders were able to articulate a range of issues – particularly in the areas of liveability, housing, transport and workforce planning – ranging from the very specific (e.g., loss of a particular officer or support program) to broad structural issues (e.g., wage disparities, skills shortages and fragmentation of the community). These issues are reported in greater detail in Kinnear (2013), and many appear to be commonplace in resource-regions (Measham *et al*, 2013). Notwithstanding this, heterogeneity in the three case study regions was again observed; for example, participants from Mackay/Whitsunday and Fitzroy noted problems with skills shortages and inability to source labour (particularly in the services industries), whereas Wide Bay Burnett participants instead cited difficulties with high unemployment.

A large number of solutions were put forward regarding ways that RDA (and others) might help regions to better respond to the cumulative impacts of resource sector activity. In examining these, no assessment was made by the research team in terms of the validity, feasibility or effectiveness of any particular 'solution'; rather, to refine the large body of material that had been contributed, ideas were grouped into six categories:

1. Areas for policy development and/or reform: this grouping mostly comprised suggestions about legislative and taxation reform, and new or revised directions for policy areas that impact upon regional futures. Policy was taken to mean either government policy, or business models/practice in the private sector.
2. Key investment areas: notwithstanding that most regional development initiatives will require some level of resourcing, this grouping was used to categorise stakeholder comments about specific ideas for direct (dollar) investment in infrastructure and/or services.
3. Leadership, collaboration and innovation: this grouping consisted of ideas about advocacy and lobbying to secure regional sustainability, partnership brokerage, and ideation (i.e., creating new paradigms about regional development in resource communities).
4. Research, monitoring and evaluation areas: this grouping covered applied research and longitudinal data collection on key regional statistics, as well as the assessment of past funding and/or programming initiatives.
5. Education, extension and engagement: this included suggestions about awareness-raising and/or capacity building across residents, governance groups and the

business community, as well as the engagement interface between RDA and its stakeholders.

6. On-ground initiatives: this 'remnant' grouping contained examples of other programs, events or operating philosophies not captured in any of the above categories. Often, suggestions were targeted at the community level where the RDA role is more likely to be one of support, rather than as a leader/driver.

Across the ten theme areas, policy reform was consistently the largest grouping; suggestions here included those relevant for the three tiers of government as well as for practice change in industry. On-ground programs and regional investment were also strong populated categories, although this varied by theme. Some sentiments were recurrent across multiple themes: these included the need for collaborative partnerships across the three tiers of government, business, industry and the community; the need for 'red tape reduction'; repeated calls for policy change around requirements for local procurement and housing for the non-resident workforce; and taxation reform. The latter had a clear focus on increased liabilities for resource sector proponents, with the raised revenue then being reinvested into the host communities. In fact, a common theme was that mining proponents should be shouldering a greater burden of regional development in their host communities – through tax arrangements, formal development conditions and/or informal social licence to operate. This debate also featured in the recent Senate Inquiry (Commonwealth of Australia, 2013).

Once the primary data on solutions had been processed, the development of action points for RDAs was targeted to cross-regional, collaborative efforts in the priority themes ranked by stakeholders, and was framed around the six 'solution areas' that emerged from the discourse analysis. Thirteen action areas were identified, with some specific for the RDAs of MIW, FCW and WBB; some directed towards a broader 'resource-region' grouping of RDAs, and others being applicable for RDAs nationally (table 3).

Study constraints

As the research was qualitative and involved relatively small sample sizes (especially within-region), detailed statistical comparisons were not performed. Potential bias in the survey response frame should be acknowledged, with most stakeholder participants being already engaged with RDA. The research was anchored in ten broad areas of regional development, however, these are not exhaustive and nor are they mutually exclusive: in fact, most regional development requires multi-disciplinarity. Respondents were not provided with a definition for each of the ten thematic areas, thus, the low-priority attached to themes such as 'governance' could signal that participants weren't clear on what the topic referred to.

3. DISCUSSION

Understanding cumulative impacts of resource sector growth and framing an RDA response

In central Queensland, resource sector impacts are clearly different amongst 'host' (MIW, FCW) and 'source' (WBB) resource regions. This is in agreement with work in other states and suggests the need for the debate about impacts of, and solutions to, resource sector development in regional Australia to be expanded beyond regions hosting construction and/or operations. At minimum, communities aspiring to engage with the resource sector economy, such as through labour services provision as a fly-in/fly-out or drive-in/drive-out hub, ought to be included. This may help to reduce some of the impacts experienced in traditional communities, one cross-regional example being sourcing the Bowen Basin workforce from the Wide Bay Burnett area, where there are high levels of unemployment, in order to relieve the pressure of labour shortages and wage disparities being experienced in the north.

In the above case study, regional stakeholders articulated a range of possible pathways to respond to resource-sector growth. From RDA's perspective, it was necessary to consider these in the context of:

(a) whether the suggested options were in fact valid as effective strategies for responding to the impacts of resource sector activity;

(b) whether pursuing any particular option is an RDA agenda, or whether it might be more appropriately driven by other organisations; and, perhaps most critically in this paper

(c) considering the factors by which it becomes evident that working cross-regionally has benefits over single-region initiatives.

The first point is of wide scope and was not tackled as part of this research. The second point required a good understanding of the pre-existing operating context for each of the participating RDAs, as well as the existing policy positions and expectations of RDA for the Australian and State government. This included being mindful of the recommendations already presented in the Commonwealth Inquiry into FIFO workforce practices. In the Central Queensland case, the three participating RDAs share a similar operating context (e.g., using a place-based approach), however each RDA participates in a different mix of initiatives, depending on the relevance and value for the particular region. The third point is discussed more fully in the section on cross-regionalism below.

The proposed action points arising from the research are expansive, and their implementation is likely to require a review of the RDAs roles and responsibilities, including how the committees are resourced. In agreement with previous studies (Buultjens *et al*, 2013), this study has shown that RDAs are presented with a difficult set of circumstances as they attempt to meet the sometimes divergent expectations of government, industry, business and the community. As one example, stakeholders rated 'policy change' as being amongst the least popular response option in Table 1; but then put forward a range of suggestions for solutions that could only be effectively advanced by working within the policy domain. Similarly, the public health topic ranked poorly in terms of regional priority, despite stakeholders indicating that the performance in this area was poor, and health being one of the specific issues flagged for RDAs to work on by the FIFO Inquiry (Commonwealth of Australia, 2013). RDAs are thus left with a considerable challenge as they attempt to balance community demands and other requirements, with a minimum of operational resources and human capacity. The recent change of Federal government presents an opportune time to enter this debate, particularly given the incumbent's stated preferred mechanisms of local engagement, which may include a greater focus on delivery through partnerships with local councils, businesses and community groups (Deputy Prime Minister's Address, 2013).

One of the driving factors for RDAs to work cross-regionally is to share resources and combining capacity. In Queensland, seven RDA committees have already collaborated on a South-East Queensland Regional Development Initiative focussing on positioning the region for the 'Asian century', with a framework specifically identifying cross-border projects (RDA, 2013). In Central Queensland, the benefits of a cross-regional approach revolve around situations whereby stakeholders (such as RDA) can more effectively pursue, resource and/or deliver solutions where these are undertaken beyond the constraints of a particular local government or RDA region. Good examples of these include lobbying for policy change around affordable housing, strategic planning of road infrastructure, and the development of whole-of-region workforce strategy.

Table 3: Action Points to Enable Regional Development Australia Committees to Work Cross-Regionally on Issues of Cumulative Impacts from the Resource Sector

A collaborative and cross-regional approach	• a network of RDAs should be formed (e.g., create a 'resource sector cluster') to share knowledge and best practice about regional development issues associated with resource sector growth.
Involvement in policy development and/or reform	• RDA should play an increased role in Australian and state policy development; including in generating the evidence base, increasing awareness about policy positions, and bringing forward ideas for policy reform that better meets the needs of regions servicing the resource sector. • The RDA resource sector cluster can lead a debate about the different kinds of regions that are engaged, or wish to engage, with the resources sector, and the positive and negative impacts that resource sector growth will have on each. There is a need to ensure that policy decisions and investment flows properly consider the implications for regions that host operations, as well as those that provide mobile workforces.
Facilitating key investment	• The structure and/or application process for RDAF mechanism, and/or programmes of similar nature could be reconsidered to ensure that the applications better reflect the preferences of regional stakeholders in terms of infrastructure investment, and that cross-regional collaboration and innovation are strongly encouraged. • The RDA resource sector cluster should work closely with the three tiers of government and the private sector, to develop a more strategically planned approach to delivering social and community infrastructure that aligns with regional priorities.
Leadership, collaboration and innovation	• There is a need to map, contrast and compare the expectations of the Federal and State Government, RDA Committees, and the community with respect to the role and deliverables of RDAs, to clarify the role of RDA as a lead agency.
Research, monitoring and evaluation	• RDAs should be provided with direct support from Australian and State offices responsible for collecting, collating and/or analysing statistical information about resource sector activity, and socio-demographic / socio-economic trends. • RDAs should play a strong role in encouraging and facilitating research on regional issues, by drawing on their local knowledge to help identify regional research gaps.
Education, extension and engagement	• The RDA resource-sector cluster should conduct regular consultation in order to generate longitudinal information on the issues, challenges and trends associated with resource-sector growth. • RDAs in MIW, FCW and WBB should continue to focus on partnerships with local government as the preferred method of tackling regional agendas • RDAs of MIW, FCW and WBB should build closer partnerships with business and industry in creating solutions to the impacts of resource sector growth, particularly with respect to transport and development infrastructure.
On-ground initiatives	• RDAs should focus its efforts on areas that are ranked as high priority by regional stakeholders • The RDA resource sector cluster should develop a methodology and/or best practice for capturing and testing solutions put forward by the community, regarding ways to reduce impacts and maximise the benefits of resource sector growth.
A collaborative and cross-regional approach	• A network of RDAs should be formed (e.g., create a 'resource sector cluster') to share knowledge and best practice about regional development issues associated with resource sector growth.

Notes to Table 3: RDA= Regional Development Australia; RDAF=Regional Development Australia Fund; MIW= Mackay, Isaac and Whitsunday; FCW=Fitzroy Central West; WBB=Wide Bay Burnett.

A broader rationale for cross-regionalism?

Demonstrating a broader rationale for cross-regionalism will require more evidence about the likely costs and benefits of this approach, as well as how cross-regionalism can be usefully pursued. Unfortunately, there is a dearth of empirical studies about specifically how inter-regional partnerships can help to tackle 'wicked' regional development problems such as cumulative impacts. Regions are often highly idiosyncratic (Polése, 2009) but this in itself this does not eclipse working together on common issues. However, some of the real problems that may sidetrack cross-regional approaches are discussed by Jesuit and Sych (2012), who reported on the preconditions for cross-border economic development, reflecting on regional development cases from Italy, Luxembourg and USA/Canada. They found that cross-border interactions were limited, influence by local competition forces, and culturally challenged in cases where political and/or administrative arrangements differed amongst the partners. Whilst the European context of 'regions' does not fit with that of the Australian experience, this work suggests that cross-regionalism will require dedicated effort as it is unlikely to occur organically. This is supported by Porter *et al*. (2013) who recorded a number of challenges in working collaboratively, including issues of ownership, commitment, variation in regulatory or economic power; and the 'churn' of those in stakeholder positions which makes it difficult to establish long-lasting relationships. Collectively, this means cross-regional engagement with require considerable time, energy and resources (Porter *et al*, 2013).

With respect to benefits, it would seem sensible to conclude that groups who work to tackle issues of mutual interest are likely to enjoy synergistic outcomes. Australian regional development is already challenged by low critical mass and fragmentation; and it is for this reason that a greater focus on collaboration and collegiality is already emerging elsewhere in the regional landscape. For example, recent initiatives by the Regional Universities Network (RUN) have seen institutions that are usually concerned with their own immediate footprint and competitiveness, turning to cross-regional strategies. Here, the collective approach is regarded as the most effective way to build capacity and sustainability (RUN, 2013). Certainly, addressing regional issues is often rooted in the adaptive: successful regional development is complex, and 'rarely does a single entity have the resources or authority to bring about necessary change' (Kania and Kramer, 2011, p. 39). Broadening the scope of potential collaborators to include those outside of immediate regional borders (physical or otherwise) thus introduces the likelihood of achieving the innovative, 'fresh thinking' approach being touted as a necessary tool for Australian regional development (CEDA and RDV, 2013). For example, Lundquist and Trippl (2013, p. 451) have noted that cross-border interaction can 'offer potential for new combinations and unexploited synergies'. Kinnear and Ogden (2013) have also illustrated the importance of innovation in tackling sustainable development issues in resource regions, noting that successfully innovative regions often feature clusters of people and/or organisations for the purposes of knowledge recombination.

One of the strongest benefits to cross-regional cooperation, and the collective 'grunt' that this might provide, is to achieve a sustained interest in formulating effective regional development policy. Cockfield and Botterill (2013, p. 138) observed that regional development in Australia has thus far been a policy orphan, with 'little institutional or interest group support … few to

defend the ad hoc decision-making that characterises this domain …[and] little continuity of programs and few policy roots'.

Notwithstanding the above, the real questions arising from this research are (a) why collaboration might be better if specifically done in cross-regional fashion, rather than simply within regions; and (b) the basis on which particular regions ought to be selected for partnering. On the first point, one criticism of past regional development activities in Australia is their small-scale nature and failure to coordinate a strategic approach (Buultjens *et al*, 2013): through cross-regional cooperation, communities can achieve scalar returns and the benefit of uncovering new areas of comparative advantage. Cross-regional efforts may also help to overcome cultural barriers that have been perpetuated in a geographic region. According to Buultjens *et al*. (2013, p. 187) 'collaborative leadership can help break down parochialism'; hence, cross-regional partnerships could address this issue which is perhaps one of the most destructive, but least well understood, dynamics at play within regional Australia.

On the second point, an interesting issue to consider is whether cross-regional relationships ought be limited to instances where regions are drawn together by issues of proximity (ie., are neighbouring one another, as in 'Central Queensland') and/or mutual interest (e.g., similar profile of challenges and/or opportunities, as in 'resource-regions'. An alternative scenario is bringing together regions who share no commonality (i.e., are neither proximal nor relational) with the intent of injecting entirely new thinking (that is, a cross-regional innovation systems approach). However, an important element is how far the place-based approach can be stretched by adding new collaborative neighbours before it is no longer truly 'place-based'? On the one hand, the march of globalisation has led some to question the value of place-based development models, principally because regional economies are increasingly porous, but also because of the 'slippery' nature of people, knowledge and resources which are more mobile now than ever before (Barca *et al*, 2012). Alternatively, there is an argument that place-based was never linked with geography, but instead was relational and about 'accommodating the heterogeneity of a place' (Sotarauta *et al*, 2012, p. 11). In this context, it could be expected that working either with geographic neighbours, or with peers that share common issues and interests, is still faithful to the 'place-based' approach, so long as the intent is to operate from a strong understanding of (cross-) regional context, and to undertake activities that have the region as the principal client. A further (and perhaps obvious) note is that adopting a cross-regional philosophy need not apply to all regional development activities; rather, a selection of issues may be tackled using cross-regionalism, according to their nature and the likely benefits of doing so. This alleviates concerns that the power of place-making would be somehow misappropriated by the formation of supra-regional groupings: if done selectively, new alliances can respond to cross-regional challenges without losing their regional roots (Schafran, 2013).

4. CONCLUSION

This study has emphasised that the cumulative impacts of resource sector development are diverse and interlinked. In Central Queensland, attention to liveability, family and social wellbeing; transport and development infrastructure; and workforce planning, skills and education will be critical in responding to the cyclical growth of the resource sector. A mix of options is needed in regional communities to help manage these cumulative effects, and there are a range of likely benefits from implementing these options from a cross-regional base.

Whilst challenges about the legitimacy and resourcing of RDAs have already been reported (Buultjens *et al*, 2013), and there is some prospect that these Committees may be redesigned

by the Coalition government, there is clearly an ongoing role for local engagement in regional development. Cross-regionalism might be considered as a new variation of place-based development that could be used to strengthen the current activities and impact of RDA committees. However, pushing networks and collaborations beyond regional boundaries is likely to require a philosophical as well as a practical shift in regional development thinking. McDonald *et al*. (2013) described various techniques to enhance collaborative working relationships, such as developing boards and staging meetings and workshops. Against the geographical expanse of regional Australia, and the preference of many stakeholders for face-to-face communication (Kinnear, in preparation), this will require dedicated resourcing which is currently unavailable to RDAs, and possibly new policy settings designed to incentivise cross-regional collaboration.

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Evaluation of Regional Economy through an Embedded Econometric-Interindustry Model

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ABSTRACT

Since incorporating interindustry analysis into econometric framework was pioneered some 40 years ago (Glickman, 1977), there has been a growing number of studies in the literature on application of the integrated framework at the subnational level. The integrated models in the literature have appeared in different forms with respect to the strategy and the structure, through which input-output (IO) and econometric are merged. The objective of the integrated framework is to capitalize on the merits of both component models, namely, an exhaustive interindustry analysis and a dynamic reflection of economic variables. This paper presents an attempt to extend and apply the interindustry demand variable (IDV) technique to embed an IO analysis into a time-series model to investigate the Illawarra economy. The result is a dynamic intersectoral model that not only represents structural changes in the regional economy, but also provides high accuracy, in forecasting total employment and output.

1. INTRODUCTION

Since the development of integrated input-output econometric framework during 1970s (Glickman, 1977), the number of studies applying integrated framework at the regional level has proliferated (Isard and Anelin, 1982; Moghadam and Ballard, 1988; Anselin and Maden, 1990; Bertugilia *et al*, 1990; Conway, 1990; West, 1991; Israilevich *et al*, 1997; Schindler *et al*, 1997; West and Jackson, 1998; Rey, 1998; Motii, 2005). The studies applying the integrated framework apply different forms of integration with respect to the interaction system and integration configuration, through which input-output (IO) and econometric models are combined. A thorough examination of the different studies in the literature reveals a common consensus on the modellers' motivations for applying the integrated models to regional policy analysis. The common credence among integrated modellers is that the standalone component models, namely, IO and econometric, are becoming inadequate to deal with the complex issues involved in economic forecasting and impact analysis at the regional level (Batey and Madden, 1986; West, 1991; Rey, 1998).

A regional IO model represents a comprehensive intersectoral structure of the regional economy, albeit it is limited to a single temporal observation and thus fails to capture the dynamic price effects and technological changes as the economy develops over time (Ó hUallacháin, 1984; West, 1991). On the other hand, a regional econometric model is dynamically oriented, in that it incorporates technological changes and price effects as the economy evolves over time. However, it lacks the detailed depiction of the interindustry

structure of a regional economy (Moghadam and Ballard, 1988; West, 1991). It is argued that regional econometric representation of the economy is a basic view of the economic interactions, skipping over some important intersectoral linkages (Wilson, 1984).

Hence the objective of embedding an IO analysis into an econometric framework is to capitalize on the merits of both component models, namely, the detailed interindustry analysis and the dynamic representation of market variables. This paper presents an attempt to investigate the dynamic properties of intersectoral relationships within the Illawarra regional economy in Australia. The result is a dynamic intersectoral model that not only represents structural changes in the regional economy, but also provides higher accuracy, in forecasting total employment and output, compared to the standalone models, namely, econometric and input-output.

2. BACKGROUND

The impetuses for developing an integrated econometric IO model to investigate the Illawarra economy are grouped into two categories: theoretical and practical. An important theoretical impetus is the claim that integrated framework offers a fully disaggregated general equilibrium structure, which helps capture intersectoral interactions within an economy (Preston, 1975; West, 1991). The integrated econometric IO model is a closed model that captures the simultaneity between supply and demand (Chowdhury, 1984; Israilevich *at al*, 1997).[1] Unlike the standalone application of the component models, namely, econometric and IO that only trace the effects of change from one side of the market (demand), the advantage of simultaneity between supply and demand gives the integrated framework a superior appeal to regional modellers. Nevertheless, two studies argue that both econometric modelling and IO analysis are classically demand-driven at the regional scale (Beaumont, 1990; Conway, 1990). Thus it is claimed that a model originating from combination of these two components cannot integrate supply and demand simultaneously (Beaumont, 1990; Conway, 1990).

It is further argued that since integration of supply and demand is a critical motive for integrating the two models, the integrated framework is to be viewed as a failure and hence to be skipped over in favour of computable general equilibrium (CGE) models (Beaumont, 1990). Nonetheless, it can be contended that this argument is a case of not seeing the forest for the trees; as such a critical motive for simultaneously capturing supply and demand interactions is an excessive objective at the regional scale, specifically as is the case for the Illawarra. Because not only is there a dire dearth of time series data for the Illawarra region, but also not all proponents of the integrated approach consider that motive very critical for integration. Moreover, development of CGE models at the regional level is oppressed by a number of restrictions related to data availability, incorporation of temporal dynamics and requirements for model calibration. As a final point, the distinction between the accuracy of the results from CGE and integrated models is argued to be a blurry one (Almon, 1991; Treyz *et al*, 1992; West and Jackson, 1998).

In contrast to the above mentioned argument,[2] the critical objective for incorporating an IO analysis into a time-series model is relaxing the restrictive assumptions of each of the two models (West, 1991; Rey, 1998; Masouman and Harvie, 2012). Constant coefficients, linear production function, and constant returns to scale are the major restrictive assumptions that

[1] In this particular context, the term "closed" refers to the treatment of the household sector as an endogenous variable. Nonetheless, the Illawarra econometric input-output model is an open model with respect to extraregional trades.

[2] There is a growing consensus among regional modellers that the main objective of the integrated framework is to relax the restrictions of each model applied alone.

can be set at ease by endogenising the sectors that are otherwise exogenous in either of the traditional models. The integrated model developed in this research is aimed to relax these limiting assumptions, making the model responsive to price movements and considering the nonlinearities in production technologies. This objective is set to increase the accuracy of the model by representing the behavioural characteristics of the Illawarra economy more realistically.[3]

Moreover, a quick review over the pragmatic impetuses of the integrated framework reveals a number of objectives that are taken into consideration for developing the following approaches. Pragmatic impetuses such as increased disaggregation of the econometric model to improve its impact analysis capabilities and separating the income generating and employment determining characteristics of the household sector are the main practical objectives for forming the integrated approaches discussed in the following sections.

However before detailing the compilation procedure for the Illawarra embedded econometric input-output model, it is necessary to provide a quick review over the national integrated models. The importance of the national integrated models relates to the fact that the main notion of regional integrated modelling originates from successful attempts of national integrated modellers (Walras, 1954; Morishima, 1964; Klein, 1978; Klein, 1983; Chowdhury, 1984; Almon, 1991; McCarthy, 1991). A review over the literature reveals that the first comprehensive attempts for construction of national integrated framework was made by Klein (1978, 1983). Klein treated the demand side of the economy by a Keynesian macro model and the supply side by a Leontief interindustry model. In a national integrated model, the Keynesian module determines aggregate estimates of GDP while the Leontief module determines the sectoral distribution of these aggregate estimates as the final demand drivers of the IO table. While the regional and national integrated models are distinctive with respect to their analytical frameworks and data availability, they share a number of mutual interactions, which are applied in building the integrated models in this paper.

In spite of the fact that regional integrated framework originates from the pioneering national integrated models, it is distinctive from a number of aspects as a result of the challenges that regional modellers are faced with. The subsection that follows provides a review of these challenges by examining the existing regional integrated models. Although there are a number of studies that provide important insights on regional integrated models (Kort and Cartwright, 1981; Kort *et al*, 1986; Beaumont, 1990; Rey, 2000), the scale of their review is mostly at a state level. They are majorly focused on theoretical challenges and not particularly concerned with comparison of performance properties of different integrating strategies. As was indicated earlier, there is a growing interest in regional integrated modelling due to their comparative theoretical and practical advantages. Hence a significant contribution to the existing studies in the literature would require application of a detailed comparison on the results of different integrated approaches to one region with evolving economic characteristics. Moreover, several methodological challenges are involved in regional integrated modelling that require attention and are not examined in the other studies. Hence, we extend the development of the integrated approaches found in the literature in order to highlight the neglected methodological challenges mentioned above and to specify an approach to treat them with respect to regional specificities of the Illawarra.

[3] The procedures are explained in the following sections.

3. BUILDING THE MODEL

The classification of the integrated models in the literature reveals three main approaches, namely, composite, embedding and linking.[4] An integration approach relates to the method and the degree to which the IO analysis and econometric model are combined. The main differences between the three integrating approaches are based on the choice of which interaction system and integration configuration are developed. The interaction system relates to the degree and the nature of the interaction between the two component modules, namely IO analysis and econometric model. The interaction nature between the component modules can be grouped into two categories: recursive or simultaneous. In the former there is a sequential ordering of the direction of causality between the econometric equations and the IO block and in the latter there is a two-way conjoint feedback and interaction between econometric equations and the IO block. The degree of the interaction reflects the scale of sectoral aggregation of the IO block with the spatial aggregation of the econometric equations. It also reflects the common specifications that are determined in incorporating one module into the other.

The configuration of the integration approach relates to specification of the mathematical equations and the method chosen to solve and operate the equations in the model. The configuration can also be grouped into two categories: compound and modular. In a compound configuration method a sequence of linear and/or non-linear equations are solved through a set of iterative algorithms.[5] The modeller can choose to retain selected aspects from both the IO block and the econometric modules to implement in the iterative algorithms. The number of iterations equals the number of time series observations. Hence for the Illawarra econometric model where there are 20 observations (1990-2010), there are 20 iterations for all the equations in the econometric blocks. The estimated results of each time series block are employed in the subsequent block and then the final estimates are disaggregated through a make matrix to be implemented into the IO table.

On the other hand, a modular configuration characterises more degree of independence in integration.[6] The mathematical formulation in modular configuration for a given point in time is solved in an order. This means that one module is operated and run to convergence before the subsequent interaction with the other module takes place. The choice of configuration can have significant impacts on error transmission throughout the integrated framework, and therefore requires a detailed scrutiny, which is examined in the following sections.

Although the two dimensions of an integrating approach, its interaction system and integration configuration, appear to be closely related, it is essential to note that it is the specific combination of the two that defines an integration approach. It can be also likely to have an integration approach that is modular in its configuration but simultaneous in tis interaction system. A great example of such approach in the literature would be the innovative framework developed by Isard and Anselin (1982) for the US economic-demographic system. However, the definition of the three types of integrating approaches in the literature originates from the combination of interaction system and integration configuration found in the existing integrated models in the literature.

The relationship between the IO analysis and econometric model varies between the three approaches. The composite approach represents a union of the econometric model and IO

[4] For more information on the three taxonomic integrating strategies, please refer to Masouman & Harvie (2012).

[5] The composite approach uses a compound configuration.

[6] The modular configuration is used for the embedding approach.

analysis. In this approach the integration involves several parts of overlay, which is in a way similar to the embedding approach, albeit each module retains a degree of autonomy which is also found in a linking approach. In the linked approach there is a slight connection between the two modules, each module remains somewhat independent with the outputs of one model becoming inputs into the other in a recursive manner. Finally in the embedded models, the IO module is completely incorporated within an econometric framework and hence the integrated structure is mainly dominated by econometric relations.

It is important to highlight some key issues that will be continuously referred to in the subsequent sections before we begin to describe the compilation of the embedded model in detail. The first relates to the embedded model's distinctions from an ideal national model from a number of points. The second relates to the more applications of the embedded approach in the literature compared to the other two approaches. This popularity is because of factors such as less intensive data requirements, simpler fundamental theoretical perspectives, and modeller's objective. Furthermore, apart from a number of the linked applications, a close correspondence is evident between the sectoral aggregations of the IO analysis and econometric model. Lastly, most of the integrated models existing in the literature are developed for a single region analysis (see column 6), and as a result there has been limited attention on the comparison of different integrated approaches.

3.1. Embedding

Among the integrated models available in the literature, the embedded approach is most suited towards modelling a region with characteristics of the Illawarra.[7] Hence it is necessary to re-review some of the important characteristics of the current operational embedded models before we begin discussing the procedure for the Illawarra embedded model. A mutual characteristic of the models within the embedded category is their objective of representing the notion of interconnectedness of industries that constitute the main foundation of a regional economy. Embedded models attempt to model this interconnection within a dynamic framework.

Industrial interconnectedness is considered a network of interindustry structural interactions where each sector services the other. Firms purchase goods and services (inputs) from firms within the same region in addition to the external firms (White and Hewings, 1982). The original notion of this interconnectedness is formed by regional IO models, albeit regional IO models are limited to a single temporal observation and thus fail to capture the dynamic structure of changes in technology as the regional economy evolves (Czamanski, 1971 Ó hUallacháin, 1984; Howe, 1991). On the other hand, regional econometric models are dynamically oriented, in that they provide a mechanism for incorporating technical change; nonetheless, they are criticised for not explicitly reflecting the interindustry transactions that take place within the economy (Moghadam and Ballard, 1988). It is argued that regional econometric models' representation of the economy is an overly simplistic view of the economic interactions and skips over many critical variables (Wilson, 1984). Hence the objective for developing an embedded approach is to capitalize on the merits of the two mainstream models, namely the detailed interindustry analysis and the dynamic representation of market variables, so as to relax the restrictions of each.

Another mutual characteristic of models in the embedded category is that they are dominated by an econometric module. The only input from the IO analysis in embedded approach is the a priori information which is employed to identify important interindustry linkages. These interindustry linkages are then embedded into the econometric equations to generate sectoral

[7] This point is discussed in detail in the following sections.

employment determination and sometimes the output demand determination. Since the main channel of integration in embedded approach is on employment determination it forms a less comprehensive type of integration compared to the composite approach of integration. The channels of integration are limited to demand-production and production-income yet unlike composite approach where the results of the production-income channel are then incorporated into the demand side of IO block, the income-demand channel is severed in embedded approach. This is chiefly because data on regional consumption and non-residential investments are not available for the Illawarra region. In addition, there is a dearth of data on many of the required variables at the regional level that would otherwise allow a more extensive method of integration. Nonetheless, the objectives of many regional policy applications of such models have been to investigate the impacts on employment and income. Hence the embedded models have been tailored to meet the objectives of modellers and the agencies that provide the funds to build the model.

As pointed out earlier, since the embedded approach is the least data intensive compared to the other two approaches, is has gained an increased popularity in application and thus there are a number of extensions and modifications of this approach in the regional science literature (Duobinis, 1981; Moghadam and Ballard, 1988; Coomes *et al*, 1991; Motii, 2005). In general, the mathematical notation of these approaches is based on the following specification:

$$EMPL_i = \sum_{j=1, j\neq i}^{n} EMPL_j \beta_{ij} + \Delta_i Z + u_i \quad (1)$$

where $EMPL_i$ is employment in sector i, β_{ij} is the coefficient that links employment in sector i to employment in sector j, Δ_i is a $1 \times k$ vector of parameters, Z is a $k \times 1$ vector of other explanatory variables and u_i is the stochastic disturbance term.

In the embedded approach, the number of sectors (denoted by n) can be equal to or greater than the number of time series observations[8] (denoted by T) available for estimation. Therefore, there can be an unlimited number of estimations for all the intersectoral coefficients in equation (1) albeit this would be impractical. Thus restrictions are to be placed on the intersectoral coefficients in an attempt to limit the number of unknown parameters that are estimated. As a result, the models in the embedded category can be separated into two main groups and further into two subgroups within each group. The criterion for forming these groups is based on the role that the a priori information plays in specification of these restrictions.

The main groups are formed based on the number of intersectoral linkages that are incorporated in the specification of the equations. There are two main groups along this dimension, partitive group and holistic group. The subgroups are then formed based on the relative intensity of the restrictions that are imposed on the coefficients that represent the intersectoral linkages. There are two types of intensity on the restrictions: loose and tight. The overall decision is made based on two criteria. The first criterion relates to the number of intersectoral relations that the restrictions determine should appear in equation (1). The second criterion relates to the form of each of the intersectoral relations that is included in equation (1). The deciding criteria for the groups and the subgroups are explained in details in the following subsections.

3.1.1. Partitive Group

Members in the partitive group, employ a limited number of all possible intersectoral linkages to specify the parameters in the equation. For instance, any particular sector could employ up

[8] In the case of the Illawarra this number is 20.

to *n*-1 possible linkages with another sector, but only a relatively small number of these may be analytically important and employed in specifying the equation parameters.

And then further distinction can be made to form the subgroups based on the intensity of the restrictions on the intersectoral linkages that are employed. As pointed out earlier, there are two degrees of intensity. In the loose intensity subgroup, the parameters of the intersectoral linkages employed in the model are determined by the sample information. Thus the role of the a priori information here is only to restrict the intersectoral linkages by excluding the rest of the parameters. In the tight intensity subgroup, the role of the a priori information, in addition to restrict by exclusion, is to identify the exact value of the coefficient that represents a specific intersectoral linkage. Hence restricting by exclusion automatically sets the exact value for the intersectoral coefficients that are not employed in equation (1).[9] The coefficients of the intersectoral relations employed in a loose intensity are estimated subject to these excluding restrictions. However, in a tight intensity their values are given by explicit restrictions. Thus the link between the a priori information and the restrictions is more intensive in the tight subgroup compared to the loose subgroup. Nonetheless in both subgroups, the parameters of the remaining variables (denoted by Z in equations (1)) are estimated bound by the restrictions on the intersectoral linkages.

Both the loose and tight subgroups of the partitive approaches apply restrictions on the relationships between employment in one sector and employment in the other sectors to decrease the dimensions of the design matrix.

Partitive Loose

The first model in this group was developed based on a national IO table. It identifies the most important intermediate sales or outputs (forward linkages) and intermediate purchases or inputs (backward linkage) for each sector (Chalmer & Beckhelm, 1976; extended by White & Hewings, 1982). In other words, only the sectors with the three of the largest coefficients in the *i*-th row and *j*-th column of a national IO table were selected to be employed in the right hand side of the equation (1), and all the rest of the sectors were excluded. Then the coefficients, employing the selected intersectoral linkages, are estimated while holding constant the excluded sectors. Another similar application of such model was adopted for the San Francisco Bay area, employing a priori information from a regional IO table to identify the intersectoral linkages for the nine counties included in the model (Prastacos and Brady, 1985). The same method has been adopted in the literature to develop single region embedded models (Gickman, 1977; Duobinis, 1981). Moreover, another extension of this approach has been applied to Toledo metropolitan statistical area (MSA), Ohio at a national level. In spite of its non-structural nature, the prior distributions for the intersectoral parameters are developed in a Bayesian vector-autoregressive (BVAR) manner to determine sectoral employment (Magura, 1990).

Partitive Tight

In models within this group of embedding approach, the interindustry restrictions are obtained in two parts. In the first part, each sector is allocated to a group where the follow-on set of groups are mutually exclusive and exhaustive (Glennon *et al*, 1986; Glennon *et al*, 1987). Mathematically speaking:

(2) $$\Lambda = \{\lambda_1, \lambda_2, \dots, \lambda_W\}$$

where λ_W is the group that the sector *i* is assigned to; Λ is the set of groups; such that $w < n$.

[9] As in when $\beta_{ij} = 0$.

Each group λ_W encompasses sectors with a high degree of interdependence which is determined by the a priori information from the regional labour market characteristics. And in the event where the a priori information is not available, a time-series exploratory analysis is employed to determine the ratio of employment between each two sectors i and j (EMP_i/EMP_j). In the exploratory analysis, the groups are identified by using the smallest coefficients of variation in the employment ratios over the sample period.

After specifying the set of sector groupings Λ, restricting exclusions are placed on all β_{ij} for the sectors where $j \notin \lambda_W$ and $i \in \lambda_W$. As an example, let's assume that $\lambda_W = \{1, 2, 4\}$, then all sectors except 2 and 4 would be excluded from the equation for sector 1. On the other hand, all sectors except 1 and 4 would be excluded from the equation for sector 2 and similarly all sectors except 1 and 2 would be excluded from the equation for sector 4. Restricting equality is then applied on the intersectoral coefficients included in the equations as follows:

$$\beta_{ij} = {}^{1}\!/_{k_i}\ {}^{1}\!/_{T} \sum_{t=1}^{T} {}^{EMPL_{it}}\!/_{EMPL_{jt}} \tag{3}$$

where k_i is the number of sectors included on the right hand side of the *i*-th equation. More specifically, the restricting equality is equivalent to the average of the mean ratio of employment in the *i*-th sector to that in the *j*-th sector over the sample period.

A modification of this second approach has been found in the literature where the mean ratio restriction is substituted by an explicit IO relation as follows (Glennon and Lane, 1990):

$$\beta_{ij} = {}^{\Psi_i}\!/_{\Psi_j}\, a_{ij}^{r} \tag{4}$$

where ${}^{\Psi_i}\!/_{\Psi_j}$ is a relative term, measured as the inverse productivity ratio for sector *i* over the same ratio for sector *j*.[10] This is used to convert the intermediate demand from an output to employment basis. In the case for the Illawarra, this is accomplished by multiplying the Illawarra IO technical coefficients matrix A^{ILW}, in which each coefficient a_{ij}^{ILW} measures shipments of output from the sector *i* to sector *j* per unit output of sector *j* within the Illawarra, with the relative productivity term in advance. The result is a $n \times n$ matrix with a typical element β_{ij} which represents the number of employees in sector *i* required per employee in sector *j*. Subsequently, the specification of the sectors to employ on the right hand side of equation (1) relies on the largest elements in the *i*-th row of this matrix. The coefficients that are employed in the equation are then based on the restricting equality for equation (1). In contrast to the partitive loose approach, this approach of embedding does not require that if $\beta_{ij} \neq 0$ then $\beta_{ji} \neq 0$.

3.1.2. Holistic Group

In the case of a holistic integration, the number of intersectoral linkages that can be embedded in the specification of the equations can be far greater and even can scale to include all the *n*-1 possible linkages for each sector. Examples and description of the models in the intensity subgroups for the holistic groups are provided in the following subsections.

Holistic Loose

As pointed out earlier, in both subgroups of the partitive approach, restrictions are imposed to reduce the span of the design matrix. This is mainly achieved by applying the restricting exclusions on sectors that are deemed less important in determining employment in the selected subsector(s). Nonetheless, there is an alternative approach towards specification of

[10] Ψ_i is the ratio of employment to output in sector *i*.

interindustry linkages that decrease the number of parameters that should be estimated. However, the complete set of coefficients of interindustry linkages are represented as unique functions of auxiliary parameter (Moghadam and Ballard, 1988). This approach utilizes a national IO matrix to generate a synthetic variable to substitute for intermediate demand for outputs of a given sector to all other sector in the regional economy. Mathematically speaking a national intermediate demand variable (IDV) would be defined as:

$$IDV_i = \sum_{j=1, j\neq 1}^{n} a_{ij}^{AU} \tag{5}$$

The IDV_i is derived from the *i*-th row of the national IO coefficient matrix and the vector of employment in all the sectors of the economy. Implementing it into equation (1) and rearranging it, determines the sectoral employment:

$$EMPL_i = \Delta_{EMP_i} Z + \nu_i IDV_i + u_{EMPL_i} \tag{6}$$

where ν_i is a coefficient of the synthetic intermediate demand variable IDV.

The IDV approach was extended to modify the intersectoral linkages to reflect differences in labour productivity among sectors in a similar fashion to that in equation (1) (Coomes *et al*, 1991a; Coomes *et al*, 1991b). The explicitly detailed equation for determining employment in the *i*-th sector would be as follows:

$$EMPL_i = \Delta_{EMPL_i} Z + \nu_i IEDV_i + u_{EMPL_i} \tag{7}$$

where

$$IEDV_i = \sum_{j=1, j\neq 1}^{n} {\Psi_i}\Big/{\Psi_j}\, a_{ij}^{r} EMPL_j \tag{8}$$

The advantage of this approach is that instead of a national IO table, a regional IO table is employed to generate the intermediate employment demand variable (IEDV), in addition to generating the productivity adjustment.

Since expressing the structural coefficients that link employment in one sector to the other sectors includes an unknown parameter,[11] both IDV and its extension, IEDV are considered holistic loose approach. More specifically, in the case of the IEDV approach:

$$\beta_{ij} = \nu_i \, {\Psi_i}\Big/{\Psi_j}\, a_{ij}^{r} \tag{9}$$

where the estimation of the auxiliary parameter ν_i identifies the intersectoral coefficient.[12] However, there are a number of potential pitfalls associated with misspecification of the *a priori* information that can obscure the estimations and hinder the process (Masouman and Harvie, 2013a). Misspecification can also impact on the model performance and the interpretation of the coefficients of the IDV and its extension, IEDV.

Holistic Tight

As of today, there are no operational examples in the ligature that employ this subgroup of embedding approach. Inherently, in such a model all the coefficients for intersectoral linkages in a specific sector are set equal to a predetermined value. It would not be based upon any variation determined by the sample information. More specifically, the auxiliary parameter in equation (9) is limited to a value of 1. This would contain all *n*-1 possible linkages rather than

[11] This parameter is estimated using both sample information as well as a priori information.

[12] This estimation along with the a priori information which is encompassed in the labour productivity and regional IO coefficients identify the intersectoral coefficient.

only a smaller number of selected linkages (Glennon *et al*, 1986).[13] Due to the obvious complexities involved in developing this model, such an approach may be prohibitive and unfeasible if applied to every sector. Nonetheless, it may be productive if applied only to the sectors whose large portion of products are sold to intermediate uses rather than final demand. However overall, partitive group would be favoured and mostly feasible to be employed to the other sectors.

Table 1: The Sectoral Breakdown of the Illawarra IO Table

The Illawarra Input-Output Sectoral Profile			
No.	Intermediate Sector	Final Demand Sector	T1
1	Agriculture, forestry & fishing	PCE	Compensation of Employees
2	Mining	I	GOS
3	Food manufacturing	BI	OVA
4	Textiles & clothing	GME	Imports
5	Wood, paper & printing	GNME	Total
6	Petroleum & coal products	IM	Employment
7	Chemical products	EX	
8	Rubber & plastic products	SLGE	
9	Non-metallic mineral	SLGM	
10	Basic metals		
11	Transport & other		
12	Other manufacturing		
13	Electricity, gas & water		
14	Construction		
15	Wholesale trade		
16	Retail trade		
17	Repairs		
18	Accommodation, cafes & restaurant		
19	Transport & storage		
20	Communication services		
21	Finance & insurance		
22	Ownership of dwellings		
23	Rental, hiring & real estate		
24	Prof & scientific		
25	Administrative services		
26	Government & defense		
27	Education & training		
28	Health & social services		
29	Cultural & recreational		
30	Personal & other services		

Source: Constructed by the author.

4. DATA

The choice of sectors used in the IO table is determined by the availability of a consistent set of time-series data for a number of variables at the sectoral level, including gross regional products, wages and salaries and employment. The primary data sources include the State Accounts, New South Wales Yearbook, Labour Force Statistics, Manufacturing Statistics,

[13] This hypothetical approach does not comprehensively refer to Glennon *et al.* (1986); nonetheless, it does resemble an extension and modification of Glennon *et al.* (1986).

Consumer Price Index, IRIS Annual Publications, plus other miscellaneous publications such as Census. The input-output table was constructed based on the sectoral breakdown depicted in table 1. The current table uses a hybrid method, which is a combination of survey and estimated data. The sectoral breakdown for the econometric model is depicted in table 2.

Table 2: The Sectoral Breakdown of the Illawarra Econometric Model

The Illawarra Econometric Sectoral Profile	
No.	Sector
1	Health care and social assistance
2	Manufacturing
3	Education and training
4	Retail trade
5	Accommodation and food services
6	Public administration and safety
7	Construction
8	Professional, scientific and technical services
9	Transport, postal and warehousing
10	Financial and insurance services
11	Other services
12	Administrative and support services
13	Wholesale trade
14	Mining
15	Rental, hiring and real estate services
16	Arts and recreation services
17	Information media and telecommunications
18	Electricity, gas, water and waste services
19	Agriculture, forestry and fishing

Source: Constructed by the author.

5. THE RESULTS

Among the integrating approaches chosen for this study, the embedded models use the least amount of data from the IRA and are seen as extensions of the Illawarra econometric model (Masouman & Harvie, 2013a). These extensions reflect the intersectoral linkages that are incorporated in the employment demand equations of the econometric model. This is done in a two-step process. The first involves expanding the employment demand specification from the econometric model to include an intermediate demand variable for each sector.[14] The second step involves adding 23 demand variable identities to the econometric model.

There are eight different types of the embedding integration approach developed for the Illawarra region. The distinction made in different types is based on a unique definition of the interindustry demand variable as follows:

1. Static interindustry demand variable
2. Static interindustry employment demand variable
3. Dynamic interindustry demand variable
4. Dynamic interindustry employment demand variable

[14] The specific form of the intermediate demand variable will vary over different types of the embedding approach to investigate the results and the performance properties of this integration in the next section.

5. Illawarra SID
6. Illawarra SIED
7. Illawarra DIDV
8. Illawarra DIED

The first four types employ the national IO coefficients in determining the relevant demand variables, while the second four types substitute the national coefficients with regional IO coefficients that are developed by the location quotients (LQ) approach explained earlier. The difference between the odd types and the even types relates to the even type's use of the inverse productivity term as in equation (8) while the odd type removes the labour productivity adjustments.[15] For the static versions (1, 2, 5, 6) all coefficients are set equal to their 2007 values. In other words, the IO coefficients, productivity coefficients and location coefficients are assumed constant at the 2007 observed values in defining interindustry demand variables for all years.

5.1. Multipliers

Multipliers are applied to capture the secondary effects of expenditure in an economy. As was pointed out earlier, there are two types of secondary effects as follows.

The first type is the indirect effects, which are the adjustments in output, employment and income within the intermediate industries in the region, in other words, businesses that supply goods and services to firms that sell them to final demand. For instance, restaurants and bars in Wollongong CBD purchase a variety of goods (food and beverages) and services (barrister, waitresses, and waiters) from the local suppliers (and households) in order to provide an amiable experience for customers visiting from Sydney. Each of the local businesses, providing goods or services to these restaurants and bars, benefits indirectly from the visitors' expenditures in the restaurants. These indirect effects are captured by Type I multipliers. In other words, Type I output multiplier equals the ratio of sum of direct sales (DS) and indirect sales (IS) to direct sales. Type I = (DS+IS) ÷ DS.

The second type is the induced effects, which are the increases (decreases) in output, employment and income in the region as a result of an increase (decrease) in household consumption expenditure of the income that was earned directly or indirectly from visitors' expenditure. An example in this case would be the Novotel hotel manager's consumption expenditure on the local products and services (e.g. if he dines at a local restaurant), which results in subsequent output and economic activities within Wollongong. These impacts are immediately noticeable in situations arising from a significant slump (or rise) in tourism in a region. In such situations, a decrease in income entails a decrease in expenditure that would also affect businesses in retail sector (the most), followed by businesses in other sectors that depend on household expenditure. Type II multipliers capture both indirect and induced effects. In other words, Type II output multiplier equals the ration of sum of direct sales (DS), indirect sales (IS), and induced sales (IDS) to direct sales (DS). Type II = (DS+IS+IDS) ÷ DS.

5.1.1. Illawarra Output Multipliers

The output multiplier for every sector is specified as the ratio of changes in direct plus changes in indirect (and induced if Type II multipliers are used) output to the changes in direct output as a result of a change in final demand. Thus for example multiplying a change in government expenditure (direct impact) for the output of education sector by that education sector's Type I output multiplier generates an estimate of direct and indirect impacts on output

[15] The odd types are the ID 1, 3, 5, 7 and the even types are the IED 2, 4, 6, 8.

throughout the Illawarra economy. Table 3 shows that professional, scientific and research sector comes first in ranking with the total output multiplier of 2.2126, followed by administrative services with the total output multiplier of 2.2067. Education and training sector comes fourth in ranking, with a total output multiplier of 2.1024. Since professional, scientific and research sector is directly associated, and to a certain degree dependent on, with the education and training, it can be inferred that education sector plays a significant role in the regional output in the Illawarra economy.

5.1.2. Illawarra Income Multipliers

Similar to the output multipliers, the income multipliers measure the change in income (e.g. compensation of employees) which corresponds to a change in final demand (direct impact). The income multipliers indicate the ratio of direct plus indirect (plus induced if Type II multipliers are applicable) changes in income to the direct changes in income. Furthermore, we can use income effects to measure the direct plus indirect (plus induced if Type II multipliers are used) changes in income to the direct changes in output as a result of a change in final demand. The results in Table 4 show that the highest income effect is attributable to the education and training sector, with an income multiplier of 0.9511, followed by health and social services, which is directly affiliated with education sector under the banner of knowledge industry, with the income multiplier of 0.9036. The lowest income multipliers belong to petroleum and coal products, ownership of dwellings, basic metals and mining. These results place an emphasis on the economic transition, which was pointed out earlier, from heavy industrial manufacturing to highly skilled labour orientation in knowledge industries.

5.1.3. Illawarra Employment Multipliers

The employment multipliers measure the ratio of sum of direct and indirect (plus induced if Type II multipliers are used) changes in employment in correspondence to the direct changes in employment. As was the case for income effects, we can use employment effects to measure the sum of direct and indirect (plus induced if Type II multipliers are used) changes in employment to the direct changes in output following changes in final demand levels. The results from Table 5 indicate that personal and other services come first in ranking, with total employment multipliers of 16.2266, followed by health care and social services, with employment multipliers of 15.7042, and third place belongs to education and training, with 14.3112 employment multipliers. These results suggest the interdependence of the sectors in the region on skilled labour and emphasizes on spatial linkages among industries.

For the second part of impact analysis, several conclusions can be drawn by comparing the models in the integrated framework with the standalone models. The first relates to the estimated impacts from the composite model; which are generally larger than the impacts derived from the IO models. This is explained because of the greater degree of endogeneity in the composite model compared to the closed IO model. In other words, in addition to personal consumption expenditures, investment, changes in business inventories, imports, and government expenditures, are endogenised in the composite model too. Whereas in closed IO models, only personal consumption expenditures are treated endogenously while the remaining elements are exogenous. Therefore, the unlimited supply elasticities of the IO analysis do not generate estimates that can be considered as the upper bound of the actual estimates of the impacts as argued by Hughes *et al*. (1991). Instead, in the case of the Illawarra economy, the induced effects associated with endogenous investment and government expenditures are the effects that result in larger estimated impacts in the composite model than the household consumption expenditures.

Table 3: Output Multipliers

Sector	Initial	First Round	Industry Supply	Consumption
Construction	1	0.4534	0.2624	0.4367
Prof., Scientific, Etc.	1	0.3971	0.2096	0.6059
Administrative Services	1	0.3150	0.1557	0.7360
Sector	**Total**	**Elasticity**	**Type I**	**Type II**
Construction	2.1525*	1.5698	1.7158	2.1525
Prof., Scientific, Etc.	2.2126***	0.7487	1.6066	2.2126
Administrative Services	2.2067**	0.8936	1.4707	2.2067

Source: Estimated and created by the author.

Table 4: Income Multipliers

Sector	Initial	First Round	Industry Supply	Consumption
Construction	0.4448	0.0912	0.0434	0.1982
Prof., Scientific, Etc.	0.6526	0.0390	0.0171	0.2424
Administrative Services	0.6286	0.0312	0.0135	0.2303
Sector	**Total**	**Elasticity**	**Type I**	**Type II**
Construction	0.7776*	0.7079	1.3026	1.7481
Prof., Scientific, Etc.	0.9511***	0.8911	1.0859	1.4573
Administrative Services	0.9036**	0.8630	1.0711	1.4374

Source: Estimated and created by the author.

Table 5: Employment Multipliers

Sector	Initial	First Round	Industry Supply	Consumption
Construction	9.6676	0.5237	0.2162	3.9038
Prof., Scientific, Etc.	11.4290	0.3985	0.1679	3.7088
Administrative Services	11.9724	0.8154	0.3702	3.0686
Sector	**Total**	**Elasticity**	**Type I**	**Type II**
Construction	14.3112*	0.9052	1.0765	1.4803
Prof., Scientific, Etc.	15.7042**	0.8249	1.0496	1.3741
Administrative Services	16.2266***	0.2070	1.0990	1.3553

Source: Estimated and created by the author.

Note: The following applies to the results in all three tables:
* represents the 3rd largest.
** represents the 2nd largest.
*** represents the largest.

The second conclusion relates to the temporal element of the impact analysis. As was pointed out earlier, there is an inherent time lag in building the IO tables and thus the temporal element for the total estimated impacts from the IO models is unknown. On the other hand, the integrated models provide the modeller with the ability to estimate the temporal element for the indirect and induced effects. This also explains why such models generate larger impacts than the IO model, suggesting that the temporal response of the Illawarra economy is important in measuring the final impact of a policy. It can also be concluded that failure to specify a model to analyse temporal responses can result in erroneous policy implications.

6. POLICY IMPLICATIONS

The results of the impact analysis, indicated that sector for professional, scientific and research sector tops the ranking, followed by administrative services sector and finally construction with respect to their impacts on total output. In terms of total impacts on income, education and training, health and social services and lastly administrative services sectors dominate the impact analysis, respectively. Finally, the significance analysis of the sectors with respect to total employment multipliers, indicate personal and other services, health and social services and education and training sectors are the top employment producers in the region.

As was pointed out earlier, these results suggest the significance of the spatial linkages among highly skilled labour oriented sectors and provide inference on the economic transition, the shift from heavy industrial manufacturing to highly skilled labour orientation, that is taking place in the Illawarra. The Illawarra economy has witnessed considerable adjustments over the last three decades. The traditionally known 'Steel City' has become a city of innovation, shifting from coal and steel to global export of knowledge, and Information and Communication Technology (ICT) (IUDP, 2013). Nevertheless, the old heavy manufacturing and mining sectors continue to be major contributors to the regional economy (IRIS, 2012).

As the results show, the sectors for manufacturing, mining and engineering still play a significant role. Nonetheless, their role is leveraged by sectors such as finance and insurance services, health and social services, education and training, tourism and retail. The education and training sector plays an imperative role with respect to total employment multipliers. This is attributed to the globally known University of Wollongong, which has a growing emphasis on research and development; the Wollongong TAFE; and the Illawarra based primary school and high school. Among the working age population, 34.6 per cent have completed 12 years of education, 16.9% have received a bachelor degree, and 6.9 per cent have completed either graduate or post graduate qualifications (ABS, 2012). Overall there are 106,220 alumni graduated from University of Wollongong as of December 2012, of which 39 per cent reside in the region contributing an estimated $447 million earnings premium to the regional annual income (Braithwaite *et al*, 2013).

Some key issues in the region are as follows. In terms of health care, the region faces some issues with respect to the exceeding demand and lengthy waits for non-urgent and elective surgeries. In addition to that, regional unemployment has been higher than the New South Wales state and the Australian national averages. Regional unemployment presently is at 6.1 per cent (DEEWR, 2012), while the national average is 5.1 per cent (ABS, 2012). There has been an increase in the already high unemployment rate following a recent slump in the steel industry due to shutdown of one of the two blast furnaces in the Port Kembla as a result of a lack of export demand and a high exchange rate for Australian dollar in foreign countries, which results in higher level of imports compared with exports.[16]

Developing strategies to strengthen the regional economy, and therefore increase the employment in labour force participation rate, could entail a number of different policies and emphases. As indicated by the results from the experiments from the earlier sections, impact of knowledge generation and importance of knowledge incentive centres are key principles in promoting such policies. Based on the results of analyses in this research, four main policies considered for the Illawarra economy are as follows:

[16] For a detailed explanation please refer to Masouman & Harvie (2013b).

1) Promote transport and infrastructure
2) Increase expenditure on education and training sector
3) Promote green jobs action plan
4) Promote the Illawarra as a preferred tourism destination

7. CONCLUSION

As explained in the previous sections, the operational models in the integrated framework are becoming increasingly popular in the field of regional science due to the higher accuracy and more realistic treatment of critical economic factors that are offered by integrated models for policy analysis. Nonetheless, most of the attention in the regional science literature has been focused on the novel application of a single integrated model to one region, highlighting the potential policy implications of that single integrated model. The underlying emphasis in the literature has been on the benefits offered by the combining the two mainstream analytical models, namely IO analysis and econometric model. However, some rather important methodological and data related areas for comparing the different approaches of integration have been ignored. Hence it can be argued that the growing gap in the literature appears to be between the results and performance properties of the integrated approaches that require an analytical examination.

Therefore, a closer analytical review of the existing national and regional integrated models was presented in this paper in order to explicitly illuminate the foundation methodologies applied for development of the integrated models for the Illawarra. Although data availability has been a major issue in the Illawarra and a great challenge in building both the national and regional models, the integrated framework offers greater accuracy and thus proves to be worth the extra effort. Integrated modellers in the US can conveniently apply the NIPA in building macroeconometric models yet a serious dearth of time series data and periodical IO tables for the regional Australia, in particular for the Illawarra, represents a major challenge and led to resorting to different approaches for estimating the required coefficient changes.

Although the lack of time series data is a serious data related issue at the regional scale, it is only one of the challenges that regional modellers in Australia have to deal with. At this time in Australia there is no regional analogue of the NIPA that is required for building a comprehensive integrated model. While the absence of regional data is well recognized as a serious setback in regional analysis (Hewings, 1990; West, 1991), it does not totally obstruct the development of regional IO models nor does it prevent building regional econometric models. Since data limitation has been an inevitable challenge for regional modellers as was explained in the review of the literature on the non-survey regionalization methods earlier. Nevertheless, uniting the two traditional models into a single incorporated model exaggerates the issue of data limitations and necessitates further attention. Moreover, as the issue of lack of data becomes more critical at the regional level, it also affects the choice of the approach used to integrate the econometric model with the IO analysis for an explicit unbiased comparison at the regional level.

As earlier explained, the choice of interaction systems and the integration configurations is the key criteria in distinguishing between the three different integrating approaches applied to the Illawarra. The three models in this classification range from embedded models at one end with the least data requirements to the composite models at the other end with the highest data and calibration requirements, representing the greatest comprehensive form of integration among the three. And the linked models placed in the middle with less degree of integration albeit higher data requirements than the embedded models.

Lastly, this paper was intended to apply the three integrated models to the Illawarra economy. The objective for applying three different models is to offer an empirical analysis for the methodological gaps discussed above. This empirical analysis compelled development of a consistent integrated regional account. The procedures for compilation of all the three approaches were detailed and the estimates obtained from a number of important data series were examined. The operational integrated models developed in this paper are applied in to examine the comparative properties of the integrated model raised above. The integrated model is also used to examine the results of the impact analysis and forecasting experiment for the Illawarra economy. Policy implications are represented and the sensitivity of the estimation results to the choice of integration approach is analysed to investigate the impact of government expenditure on key sectors in the Illawarra economy.

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FIFO, Flexibility, and the Future: Does Becoming a Regional FIFO Source Community Present Opportunity or Burden?

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ABSTRACT

The resources boom in Australia resulted in considerable competition for both skilled and unskilled labour, particularly in remote mining areas. Shortage of skilled labour led mining companies to source workers from far afield, while the high incomes created by a tight labour market drew labour from across the country through long distance commuting arrangements such as fly-in, fly-out (FIFO) and drive-in, drive-out (DIDO). While much recent literature has focussed on the impacts on receiving communities of these long distance commuters, less attention has been given to the experience of source communities. This paper compares the situation between two regional towns in which long distance commuters reside. The first, Busselton in Western Australia, is among several chosen by Rio Tinto to be labour source communities. The second, Stawell in Victoria, is looking to long distance commuting as a response to the impending closure of their existing gold mine. Hence the case studies offer insights, not only about source communities' experience of FIFO and DIDO, but also a comparison between the bottom-up approach of Stawell in trying to establish FIFO with the experience of Busselton which has been chosen (top-down) by a mining company for labour sourcing. This paper will consider the opportunities the Rio Tinto employment strategy offers to rural and regional communities which are keen to retain their population. The paper will highlight some community development challenges which have been encountered and how these might be addressed, especially by towns such as Stawell which is seeking to promote itself as a source community for skilled mining employment.

1. INTRODUCTION

The mining boom of the past decade has brought significant wealth to public and private sectors across Australia. However numerous economic reports (Garton, 2008; Reserve Bank of Australia, 2009; AEC Group 2012) have reported economic pressures and social disruption associated with uneven distributions of mining wealth and benefits. Spatial disjunctions between the population and workforce clustered primarily in coastal regions, and major resource extraction projects located predominantly in remote and regional areas have been identified as a further contributing factor.

Until the 1980s established mining towns such as Kalgoorlie (WA), Broken Hill (NSW) and Emerald (Qld) and purpose built company communities such as Pannawonica (WA) and Leigh Creek (SA) accommodated permanent residential workforces in proximity to particular

mining operations. Since the 1980s the locally resident component of the workforce has increasingly been supplemented by the use of long distance commuting (LDC) workforce arrangements (Hoath and Haslam McKenzie, 2013; Haslam McKenzie *et al*, 2013). Long distance commuting (LDC) arrangements may include fly-in/fly-out (FIFO), drive-in/drive-out (DIDO) and bus-in/bus-out (BIBO). The use of non-residential workforce involving block shifts and LDC is now common in the mining sector and associated industries across Australia. Such workers regularly leave the source community, in which they maintain their usual place of residence, to live away from home and family at a distant place of work during extended rostered work blocks, returning home for furlough (Hoath and Haslam McKenzie, 2013). These types of arrangements are increasingly common because of factors such as: a limited availability of suitably skilled labour in remote and regional areas; housing and infrastructure shortages; difficulties of relocating employees and families; periodic peaks in demand during mine construction, maintenance and operation, and workforce preferences (Haslam McKenzie *et al*, 2013).

Despite the above challenges, it appears likely that LDC will remain a part of the socio-economic landscape of regional Australia for the foreseeable future. Industry bodies and individual companies continue to express a preference for flexible cost-effective arrangements rather than costly infrastructure development for residential workforces, particularly for construction phases and shorter term operations in remote or inhospitable localities (Hoath and Haslam McKenzie, 2013; Chamber of Minerals and Energy 2012). There is also evidence that for a considerable proportion of the industry workforce, such arrangements have become the preferred mode of employment. A recent survey was conducted as part of a detailed case study in 2010-2011 under the CSIRO Minerals Down Under Flagship (Hoath and Pavez, 2013). Results revealed that, despite preferential 'employ local' policies introduced by mining operations, workers chose to reside in mine camp accommodation during work blocks while driving to and from regional and metropolitan centres where there are families are located.

Mining activity has achieved exceptional levels in the last decade and unprecedented labour demand has attracted record numbers of in-migrants especially in mining States such as Western Australia and Queensland. Consequently, there has been an escalation in the rate of long distance commuting. Commercial and charter flights crisscross the country taking resource sector workers between urban hubs and remote mine sites. The number of long distance commuting workers in Australia is difficult to know because the Australian Bureau of Statistics does not collect information specific to FIFO/DIDO workforces. Therefore, estimates regarding labour force mobility, particularly for the resources sector, vary widely. It is modestly estimated to be between 90,000 and 110,000 people (KPMG for the Minerals Council of Australia, 2013).

Attraction and retention of resources sector workers has been problematic during the mining boom which commenced in about 2001. Labour force churn has been a challenge for mining companies who work hard to retain trained and experienced staff. Rio Tinto pioneered the use of directly flying employees from specific regional Western Australian towns to Pilbara mine sites in 2006 and, since then, the practice has expanded so that about 33 per cent of the Rio Tinto FIFO workforce currently flies from regional Western Australian centres to seven Rio Tinto mining operations in the Pilbara region. 'Door to door' transport arrangements have proved very popular with both mine workers and their families, allowing workers more time at home due to less time spent travelling to work.

Meanwhile, in the Victorian town of Stawell, which has been a location for gold mining since the 19th century, the remaining resource is becoming more difficult to extract and hence less economically viable. The mining company is foreshadowing closure. Many of the workers,

however, are keen to remain in the industry while also retaining their home base in Stawell. Long distance commuting, specifically FIFO, is an option being considered by a group of workers as a response to the impending closure of the local gold mine. The strategy is being promoted by the local government authority which is keen to retain families, and particularly an income-generating skilled workforce, in the regional town.

This paper compares the situation between these two regional towns. In the next section, the Busselton case study will be introduced and the Rio Tinto regional labour force attraction strategy examined. The Busselton study was undertaken in 2012-13 using an iterative mixed-method approach to collect and analyse comprehensive qualitative and quantitative data sets. ABS data and local research provided quantitative insights while interviews and focus groups provided an in-depth understanding of the socio-economic impacts of long distance commuting work arrangements on source communities.

The Stawell case study is used to review the factors that have led the town to consider pursuing FIFO as a way to retain the town's skilled mining population. While undertaken independently of the Busselton project, this study used interviews with key informants as well as ABS data and data held by the local mining company to provide a similar mix of qualitative and quantitative information as in the Busselton study.

Lessons learned from the Rio Tinto strategy will be used to assess the potential for transferring such strategies to areas like Stawell which is seeking to promote itself as a source community for skilled mining employment.

2. BUSSELTON CASE STUDY

Introduction

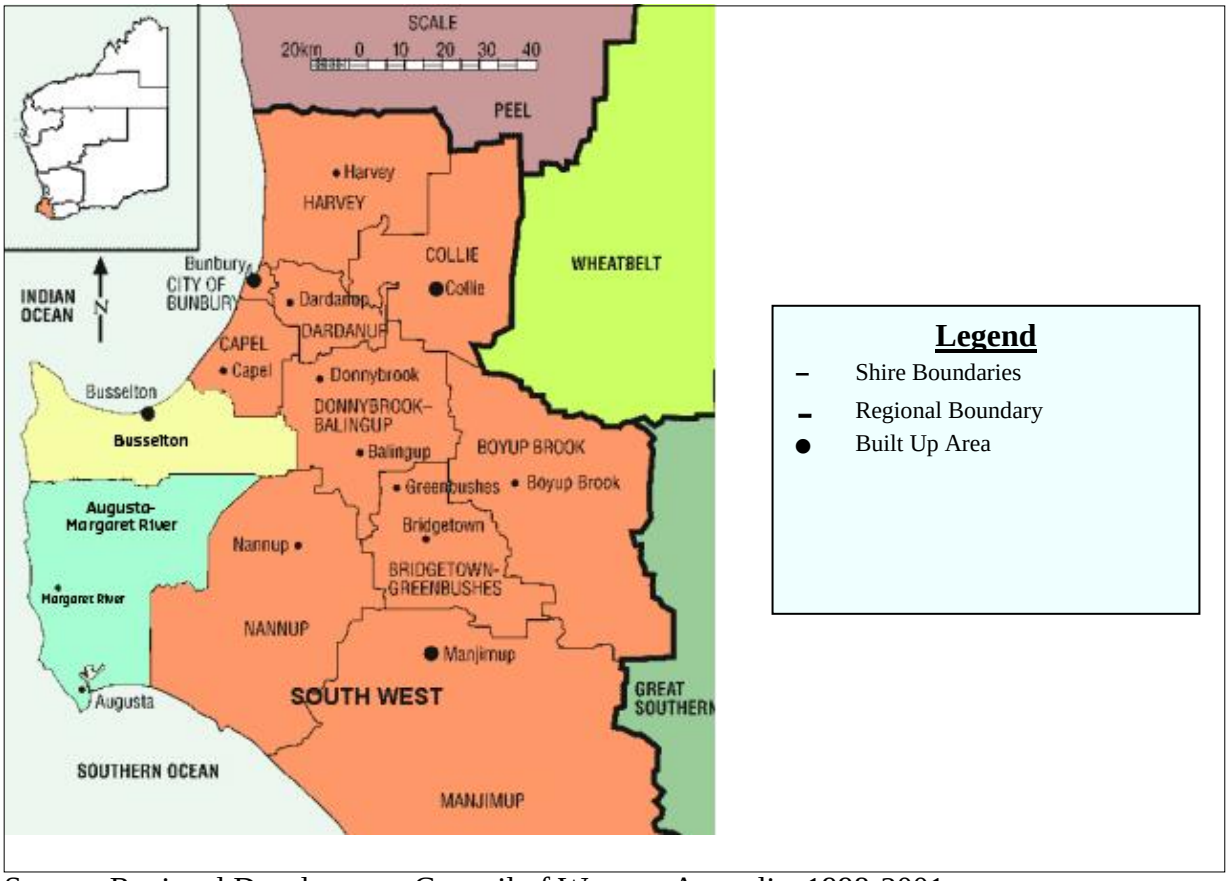
Busselton is a coastal town located 220 kilometres south of Perth (figure 1). It has a population of 33,000 people, accounting for approximately 14 per cent of the South West regional population, and has been consistently growing since the 1960s (ABS 2012).

In the last 50 years Busselton and the surrounding area has developed as a sea/tree change community characterised by a high percentage of part-time residents (many of whom are baby boomers transitioning to retirement) and a high proportion of retirees (Hoath and Haslam McKenzie 2013). The trend has contributed to a diversification of the local economy. While broad acre agricultural industries underpin the local economy, new industries such as viticulture, tourism and leisure industries such as surfing are all well established. However, along with other communities in the South West, it has struggled to remain viable in the face of a weakened tourism industry due to the high Australian dollar, a glut in the wine industry, slim margins in the dairying industry and a relatively high proportion of social security recipients in many of the local government areas. Several economic audits of the local Busselton economy, supported by ABS statistics show that the assets, education and personal income descriptors for a significant proportion of the permanent population convey a picture of disadvantage, despite many residents having post-school qualifications (Hoath and Haslam McKenzie 2013, Haslam McKenzie and Johnson 2004, ABS 2011).

The Rio Tinto regional labour force strategy

Rio Tinto pioneered the regional labour force strategy in Busselton in 2007, following the successful establishment of Rio Tinto regional employment hubs in Geraldton and Broome in 2006.

Figure 1: The South West Region of Western Australia, Including the Twelve Local Government Areas and Locations of Major Towns (Built Up Areas)



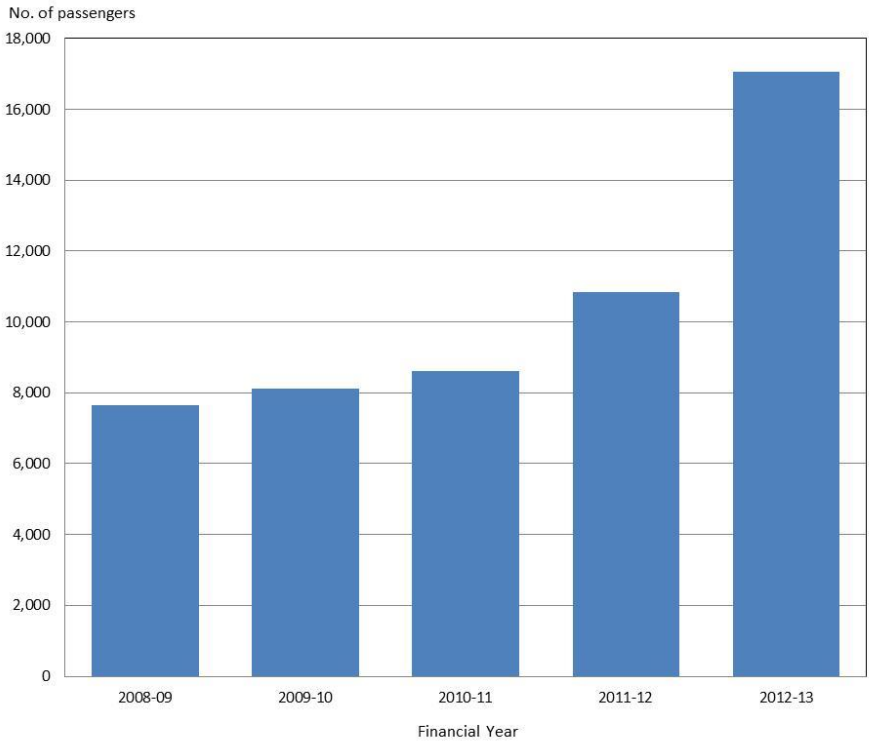
Source: Regional Development Council of Western Australia, 1998-2001.

The Shire of Busselton developed a new airport east of the town in 1997 hoping to capture more of the international and interstate tourism market. Unfortunately, this strategy failed and there are no regular commercial services from this airport; it was underutilised and operating at a financial loss. The Busselton Chamber of Commerce and Industry (2011) estimated that approximately 5,000 people working on a FIFO basis lived within 100 km of the Busselton airport. With encouragement from the Shire, Rio Tinto began their direct charter flights between Busselton and specific Rio Tinto mine sites. The strategy was an immediate success for both the company and the community. Data provided by Busselton airport in March 2013 show a steady increase in the number of passengers through the doors since then, and particularly since 2011 (figure 2).

Although Rio Tinto is the only company regularly using Busselton airport, it is not the only mine-work employer of residents living in Busselton and the South West more broadly. All other resource sector workers either drive several hours to work or they drive at least two hours to Perth airport and then take a minimum two hour flight to remote area mine sites. Many workers complain that the fly/drive mode of travelling to and from the worksite is enervating, involves personal costs and reduces the length of time spent at home.

The research has clearly shown that direct flights from Busselton to Western Australian mine sites have become the preferred option for many workers. Many have demonstrated a willingness to change companies and/or move to the South West because of the opportunity to take advantage of the direct flights (Haslam McKenzie and Hoath, 2013).

Figure 2: Number of Passengers Travelling through Busselton Airport, 2008 to 2013



Source: City of Busselton, 2013, unpublished data.

Social and economic outcomes for Busselton

The increase in the FIFO population has had direct economic implications for both the individual employees and their families, who benefit from high salaries. In addition there have been indirect multiplier effects on the local economy, derived from local income expenditure or wealth generation. Research by Haslam McKenzie and Hoath (2013) indicates that the difference between working in a FIFO position as opposed to an equivalent local position could provide an annual salary increase of approximately $40,000.

Although Rio Tinto is not the only resource company or contractor employing in the area, it has been calculated that Rio Tinto alone now spends about millions on wages, community investment, contractor and other payments in Busselton per year. This includes local sponsorship and grants, including an Aboriginal football carnival and other sporting events, a film festival and musical gala. The company also pays Busselton airport fees which flow directly to the local government authority.

Financial security was an overwhelming reason why many employees in the resources industry participated in FIFO work arrangements although the circumstances motivating this choice were diverse (Haslam McKenzie and Hoath, 2013; Hoath and Haslam McKenzie 2013). During interviews, most, but not all, participants regretted they had to work away from home for block periods of time, but almost all enjoyed the financial rewards the mining industry afforded them and their families. A number of interviewees indicated they were long term residents of the Busselton or South West region and had taken up FIFO employment as a way to remain in the area after struggling to survive as small business owner-operators. Many of these were in the construction trades or tourism industry. Others had been employees of small businesses that were struggling, especially since the global financial crisis of the late

2000s. Interestingly, amongst this cohort, many felt that regularity and security of FIFO allowed for more quality time at home.

FIFO workers resident in the Busselton area typically prefer to shop for everyday goods locally and support local businesses. However, most interviewees indicated that at least a proportion of their income flows outside the Busselton area for a variety of reasons. This includes a high level of mortgage repayments, overseas holidays, and reported lack of choice for goods and services, inflated prices and internet purchases.

The considerable variation in median salaries in the Busselton area was cause for some local concern for a widening gap between the 'haves' and the 'have nots'. Changes in the community dynamic associated with FIFO appear to be keenly felt, finding expression in a degree of resentment towards of FIFO workers and their families and inflated expectations about their ability to spend. There was also anecdotal evidence of FIFO some opportunism. Many interviewees reported that, in the local community, FIFO workers were seen as being able to afford higher prices and suspected that quotes and even invoices were inflated when it was known they were FIFO workers.

There was also evidence found of considerable pressures at individual and community levels. Service providers such as counselling services, school support services and community/NGO organisations noted an increased demand for their services from FIFO families and employees.

Nevertheless, interviewees and their families agreed that it is the manner of dealing with the challenges that is important. Many workers and spouse confirm this through their enthusiasm for their life choices, and their positive approaches to managing intermittent contact, fatigue, and loneliness. These are not reasons to dismiss the considerable challenges thrown up by FIFO workforce arrangements, but rather serve as evidence of the need to give adequate attention to understanding and addressing these challenges, ensuring that the ameliorative measures are adequately resourced and supported in practical ways (Hoath and Haslam McKenzie, 2013).

Many submissions to the House of Representatives FIFO Work Practices Inquiry (House of Representatives Standing Committee on Regional Australia 2012) highlighted a perceived lack of support services for the families of FIFO workers (and also for the DIDO commuting workers in some instances) who had found the work arrangements, especially the block time away from family, challenging. However, no service provider consulted was in the practice of routinely documenting the FIFO or DIDO status of its presenting clientele. This means that data on the type, scale and intensity of community service demands particular to long distance commuting lifestyles, or to an increasing cohort of such commuters, remain largely anecdotal.

These informal assessments are broadly consistent with separate studies by Sibbel (2010) and Greer and Stokes (2011) which found no evidence to show that FIFO or DIDO work arrangements are correlated with the divorce and separation rates of workers. There is no definitive evidence to suggest that such arrangements cause marital breakdown or other social dysfunctions which might contribute to increased demand for social support services. However there has been an increased demand for services in Busselton that is largely consistent with population growth. The fact that FIFO work arrangements have attracted people to Busselton and the South West area more generally, has contributed to such growth. Further, delivery of many support services is based on a centralised regional model and may lag behind population growth, especially rapid growth. Since FIFO workers have been part of the population growth, they have been a visible and therefore easy target group to blame.

In other words research in the Busselton community has confirmed that the presence of a FIFO population has disproportionate local effects, both positive and negative, at a number of levels:

- economically, because of the high levels of remuneration it attracts;
- personally, because of the specific demands it places on individuals through its regular disruptions to intimacy, support and routine; and,
- socially because of its apparent dissonance with the established norms and rhythms of institutional activity, and social interaction, which have evolved over time around the ideal of nine to five working days and five day working weeks (Hoath and Haslam McKenzie 2013).

3. STAWELL CASE STUDY

Introduction

Stawell is a town of 5,737 people located in western Victoria. The current underground gold mining operation has operated for thirty years employing approximately 350 people at its peak in the last decade. In 2012, the mine's closure was announced because of reduced profitability caused by increased costs and the depth at which the gold needed to be extracted. In response to the impending closure, the opportunity to undertake fly-in fly-out (FIFO) or drive-in drive-out (DIDO) commuting to other mines in Australia was identified. Local business owners and the local council have been heavily involved in pursuing this goal, driven by a desire to: utilise the mining skills base of the local workforce; retain the town's population, and take advantage of the demand for mining skills across Australia. The co-incidental upgrading of the local airport gave an additional boost to the prospects of developing FIFO opportunities from Stawell.

In mid-2013, an interview-based study was conducted in Stawell in order to better understand the ways in which the FIFO proposal had emerged. The informants chosen for the interview phase of the project included local government officers, business owners and operators working directly with FIFO activities, and workers who are currently involved in FIFO / DIDO commuting or who are considering doing it in the future. The experience of the council and the community putting their idea into action has highlighted local initiative and leadership, however there have also been challenges and obstacles which may not be able to be addressed at the local level. Analysis of quantitative data was also undertaken in order to provide a descriptive profile of the Stawell mining workforce. Some of this data came from the ABS Census while other data were obtained directly from the operators of the Stawell Gold Mine. These data provided an account of worker numbers and the location and labour force characteristics of those who has been retrenched, transferred or retired over the 2012-13 period.

Development of FIFO in Stawell

Workforce mobility has been a reality in regional areas for many decades, particularly among groups who undertake seasonal work such as shearing or harvesting. The difference between this type of mobile workforce and those doing long distance commuting (FIFO or DIDO) is that the latter return to their place of residence on a regular basis, often after a block of working time, typically one or two weeks in length.

The development of FIFO in Stawell contains several converging threads – Council initiatives, business initiatives and the prospect of the closure of the Stawell Gold Mine. The announcement in late 2012 of the closure of the Stawell Gold Mine prompted action on a

number of fronts. The local council, Northern Grampians Shire, began a coordinated exploration of FIFO opportunities, building partnerships with local business people such as the airport operator and local construction firm, the mine owners and an interstate municipality. The aim was to make links with mining regions and establish a FIFO arrangement with them, capitalising on the number of workers becoming available as the Stawell Goldmine phased down its operations. The council's motivation to engage in the initiative is multi-dimensional but ends with a desire to ultimately retain population and a rate base. It is a decision rooted in the town's identity as a mining stronghold and the fact that it possesses within its current population a significant body of mining knowledge built over generations. These initiatives coincided with those of the local businesses themselves who were able to capitalise on existing networks within the mining industries and contract arrangements with interstate mines.

Two private firms are at the heart of the current FIFO operation – a crane hire and rigging company with a contract in Cobar, and the local airline company based in Stawell which offers charter flights to Cobar. It was through the crane hire company winning the contract in Cobar that the idea first gained traction in the local private sector. Initially, the director of the company was driving his workers between Western Victoria and Cobar on a week-on week-off roster. The eight hour drive would take up the better part of two days considering both the outbound and return trips. Not only did this eat into workers time off, it also exposed workers to the dangers of many hours on the road, sometimes after a full days labour. Through negotiation between this company and the local airline, the idea for a chartered flight to Cobar was born, and the first direct FIFO arrangement from Stawell began in early 2013 with a small crew being flown to and from Cobar.

Other long distance commuting arrangements (usually a combination of FIFO with DIDO) had already been developing before this recent initiative. In many cases, road commuting has been used to access a more distant airport, and this has led to quite complex arrangements. Some locals are working in interstate mines travelling via Adelaide or Melbourne.

Stawell has a number of factors which make it suitable for future FIFO expansion. It has an airport capable of running charter flights and a local aviation company willing to expand to meet demand. The local workforce has been involved in the mining industry for decades and the workforce is therefore 'job ready' for many other mining opportunities across Australia. Support for the concept has been gained across various sectors of the local community – business, government and local workers. The town itself is an attractive place to live being near the Grampians and being within an hour's drive from regional centres like Horsham, Ballarat and Bendigo.

The expansion of FIFO opportunities is widely supported across the Stawell community. There has been discussion and consultation between local government, local businesses and existing and potential FIFO workers. FIFO is certainly seen as preferable to DIDO and if, 8 days on, 6 days off rosters were available, many would take up FIFO opportunities, including those with families. Becoming a regional hub is also seen as a way to attract workers through Stawell, even if they live in the broader region. In the short to medium term there is likely to be some expansion of the existing FIFO arrangement with the local crane hire and rigging company. The fact that other Stawell workers are travelling interstate also highlights the potential for flights to destinations other than Cobar.

The upgrading of the Stawell airport has included runway improvements, lighting, fencing and signage, completed in August 2012 (Ryan and Rich-Phillips, 2012), and the construction of a small terminal building which is due for completion in September 2013 (ABC News, 9 August 2013). Although the Stawell airport is being upgraded, it will remain without the

necessary infrastructure to enable commercial passenger flights to operate. Commercial passenger services would enable individual ticket purchase but it would also require a suite of upgraded facilities such as check in and security. This 'step up' to the next level is a highly expensive one given the increase in operating costs, staffing and the need to meet and maintain rigorous standards around security, quarantine and so forth. For this reason, even with the upgrade to runway and terminal, Stawell airport is limited to chartered flights involving an arrangement whereby the client must rent the entire plane, assuming responsibility for all the passengers aboard. This becomes an issue for profitability and flexibility for the airline operator as they can offer a plane at a single price to a client but cannot offer single seats for sale.

Current users of the local airline services are very keen to have the Stawell terminal expanded to cater for passenger flights and increase the flexibility of the services offered while reducing the costs associated with taking full responsibility of a charter plane. Conversely the Local Government sees the costs of establishing and maintaining such a terminal as hugely prohibitive and has all but dismissed the idea completely. This has not stopped ongoing discussion around the idea within the Stawell FIFO community and there still exists a strong belief that this is a plausible proposal and that higher levels of government could assist in achieving such a goal, particularly in terms of overcoming perceived or real 'regulatory burden' and 'red tape'.

Airport infrastructure is only one part of making FIFO successful. The actual logistics of organising and aligning rosters and achieving a critical number of workers for a particular mining destination can be one of the biggest challenges in capturing and expanding FIFO opportunities. Nevertheless, with the Stawell mine closing a larger number of workers would become available and this may enable more FIFO opportunities to be realised.

The need for coordination and negotiation in this process was recognised by a number of those interviewed and, indeed was seen as a prerequisite for the expansion and success of FIFO in Stawell. The need for coordination was also highlighted in relation to the often ad hoc way in which different individuals find FIFO work opportunities, thus lessening the collective advantage of developing a town-wide strategy.

Benefits and costs of FIFO

Long distance commuting presents many challenges for those involved: separation for periods of time, potential loneliness and isolation and disruption to prior patterns of work and leisure. Nevertheless, as was the case for Busselton, the Stawell interviews highlighted that many 'regular' jobs present difficulties through long work shifts or deregulated working hours. Individuals and couples respond differently to such challenges and, while long distance commuting may place destructive levels of stress on some relationships, it tends to exacerbate issues rather than create them on its own. The FIFO lifestyle may suit some people better at some stages of life rather than others, although there are many exceptions here as well. Perhaps one of the most important factors is the detailed nature of the work arrangements. Shorter block rosters such as 8 days on, 6 days off were reported as much more family friendly that arrangements with much longer periods of absence.

Another factor which appears to be important is whether the individual or family enter the FIFO lifestyle fully informed or aware of what it entails. In this respect, the fact that Stawell has a number of people involved in FIFO and DIDO appears to have the benefit of first-hand information being available to those who may be considering the lifestyle. Additional support from local Council and regional health care organisations have formalised this process to some degree through the establishment of regular support and information meetings.

4. POLICY AND COMMUNITY MANAGEMENT STRATEGIES

Findings from Busselton

The growth of FIFO and DIDO workforces residing in Busselton area has brought economic and social benefits and challenges. However, it is generally the challenges associated with such commuting that have attracted the most media attention and public concern. The research by Hoath and Haslam McKenzie (2013) highlights that FIFO workers are a diverse group, but not intrinsically different to workers in other sectors of the labour force. The findings from Stawell also support this finding with some of those interviewed suggesting that the time away from family resulting from FIFO did not necessarily represent a greater problem than a job with long hours (DTPLI, 2013). However, despite the economic reward they attract, the distinctive rhythms of FIFO rosters do generate particular challenges for individuals and for the wider community in which they reside. These require careful management to mitigate any simmering tensions and resentments between newcomers and established sectors of the community. It is important to note that some of these tensions have a history that is longer than the presence of FIFO, emerging in earlier decades as an aspect of changing demographics and structural arrangements associated with sea change trends (Haslam McKenzie and Johnston, 2004).

There have already been a number of joint initiatives between the most prominent mining company sourcing the area, local government and local interest groups to address some of the challenges arising, especially for FIFO workers relocating to the area. Forums and enhanced community family services are among the initiatives that have arisen. Nevertheless, there is an urgent and ongoing need for collaborative approaches to strengthen and maximise existing formal and informal support networks with clear and effective mechanisms to integrate both established residents and newcomers. Collection of accurate data at all levels about the size and mobility of FIFO and DIDO populations is a vital component of such strategies that will allow for more informed policy and planning.

The recent opening of a regional office in the town by Rio Tinto has been seen by the locals as a sign of a sustained commitment to the town. The office has the potential to become an important site from which to facilitate a greater understanding within the wider community of the challenges and demands of mining lifestyles as well as the potential benefits. Local government and community groups can foster initiatives to welcome and integrate FIFO workers and their families into the community and minimize tension around perceived disparities in economic circumstances. This could include community-based programs which encourage individual and community wellbeing through informal and formal support networks.

There is a role for business associations in understanding and adapting to increasing FIFO populations. There needs to be a community understanding of local spending patterns and sources of economic leakage. Strategies to strengthen the local economy and encourage local expenditure and investment are important.

Apart from the multiplier effects which can come from mining income, this is only one economic effect. Another relates to the new skills that come from resource employees in the town and the skills development opportunities that can be generated. For example, the local technical training college has developed special training courses to assist mining industry aspirants to enable them to be ‘job ready’. The courses are targeted at the semi-skilled level and, during interviews in Busselton, it was reported that these courses were having broader regional benefits not limited to the mining sector. This type of skills expansion is also seen as

important to leaders in Stawell who see the opportunity to develop more mining-related training within their town through retaining their mining workforce via FIFO.

There is a need for systematic documentation and analysis of the service needs of FIFO workers and families, across a range of services, as the basis for equitable and accessible service provision. Some services could be more effectively scheduled and delivered to workers and residents who do not have conventional work arrangements (Hoath and McKenzie 2013).

Absence from family and friends because of FIFO work arrangements is not easy and there are strategies which could be utilised to mitigate some of the stresses. Mining companies and local support services could collaborate to provide adequate pre-work preparation. LDC has provided individuals and communities considerable benefits and opportunities but it also brings with it challenges which need to be understood and carefully managed at all levels if the benefits are to be enduring. Clearly understanding the personal stresses of FIFO for both the commuting worker and the family left at home assists couples and families to make informed decisions about work arrangements and develop strategies to deal with potential conflict, including basic management of personal finances.

In both Busselton and Stawell, the provision of family friendly work swings (eight days on and six days off) was the much preferred work arrangement. This not only worked better for families but facilitated FIFO workers to be more involved with their community which they appreciated.

Ongoing careful and collaborative management is required on the part of all parties, government, community, individuals and the resources industry, if the many pitfalls of a narrowing economic base and resource dependency are to be avoided.

Findings from Stawell

Northern Grampians Shire recognised the charter service as a concept which should be supported and over time could possibly be expanded to support a larger worker base, a base which would no doubt require employment opportunities if and when the SGM closed. The shire became highly involved with the FIFO idea, developing relationships with the Cobar City Council and creating a specialised role within the council ranks to represent on this issue. The shire continues to be highly involved in developing relationships with mining companies and contractors in order to maintain the energy created behind this issue and forge new FIFO possibilities into the future. They also continue to be focused on the future of the Stawell Gold Mine itself, whether in its current capacity as an operating mine or the possibility of it becoming a centre for safety training into the future once the mine ceases current operations.

Northern Grampians Shire has made a concerted effort to provide stimulus and direction to the expansion of the FIFO source community concept. They have won praise from the director of the local crane hire and rigging business for their facilitation of relationships between Cobar and Stawell. From the Council perspective, this relationship extends beyond economic interests. The idea of developing a ‘friendship’ relationship between Stawell and Cobar presents an interesting approach to the issue of differential impacts of FIFO in source and receiving communities – rather it seeks a combined community approach.

> *... it’s about being able to have our civic leaders deal with their civic leaders. We can provide support mechanisms both ways. It’s a little bit like that friendship city, sister city relationship stuff. It could be more than just mining that we do exchanges on, it could be some cultural stuff, it could be other community support, other things that we can provide assistance with that they don’t have... What can we do to make it a good experience both ends? If our workers who are family-oriented here are in Cobar and they’re spending two week shifts on, what is it that we*

> *can help facilitate so that they get involved in community life there as well, so that they don't feel as isolated, that they feel that their citizens of two towns not just one.* (Interview 9 cited in DTPLI, 2013)

The Shire, in conjunction with Grampians Community Health has initiated an ongoing weekly meeting group for those currently doing or considering FIFO. This support role is one that is linked to wider goals such as the retention of population. The extent to which the council has been involved up to this point has been seen as positive but it has also taken up significant resources from a local council already struggling under endemic country LGA issues including an aging population, declining employment opportunities and a diminishing rate base.

There is a clear understanding around the extent to which the council can force expansion of the present FIFO arrangement. Respondents articulated that council could only do so much insofar as making Stawell look like a receptive candidate for selection by larger mining companies. There was an understanding that relationships could be created, logistical problems minimised and infrastructure provided by government but ultimate decisions to actually make Stawell a FIFO hub would be made by and between private firms. Community engagement and involvement in supporting FIFO was also seen as important.

Examples of community support activities were raised in the interviews, for example, social 'get togethers' for FIFO workers and their families. This type of activity reflects a broader movement of support which is now emerging in the form of web networks who arrange local activities for those involved in FIFO (particularly the families of FIFO workers). The "FIFO Families" website outlines many schedules activities in all States of Australia and New Zealand (www.fifofamilies.com.au).

One of the ways in which networks can assist people considering undertaking FIFO is simply by making information available about the day to day realities of the lifestyle. This is particularly important so that individuals or families can make informed choices about undertaking such work. The weekly support meeting in Stawell is seen as playing this role and it is anticipated that more people will attend as underground mining operations wind down.

5. Issues, Debates and Uncertainties

FIFO and population retention

For Council, the opportunity to expand FIFO activities represents a strategy for maintaining existing population numbers and potentially to attract new residents to the town. This role was also recognised by non-Council interviewees. The fear of losing population is apparent in many regional towns like Stawell, even without an impending industry closure.

The process of population loss in western Victoria has been occurring since the 1960s. The reasons for this trend have included: capital intensification of agriculture requiring fewer workers; rationalization of services into larger centres; increased personal mobility allowing people to access goods and services further away; and increasing economic and social attractiveness of urban lifestyles. Because of these factors, towns which are remote from large urban areas face particular challenges in retaining and attracting population. In addition, the populations of regional areas are usually older than those of metropolitan or large regional centres. This creates more challenges for population growth as numbers of births become lower than the number of deaths. In such situations, population growth has to come from inward migration and this, as outlined above, is difficult within the context of economic and social change.

The promises of FIFO expansion needs to be seen within this context. On the positive side, Stawell does have the potential to retain families and young adults if a diverse range of employment is available. FIFO effectively expands the opportunity to access a wider range of jobs, experience and career pathways than would be possible from the local economy.

Many of the locations in Australia vying to develop as FIFO hubs have high natural amenity values and this is seen as a key attractor to attract population. Stawell has many natural advantages particularly its proximity to the Grampians. It also has services and relatively cheap housing. Nevertheless, the 'attraction' of affordable housing is often misunderstood. While cheap housing sounds good from a buyer's point of view, low house prices generally reflect low demand and low demand suggests that people are not beating a pathway to the location. It is very easy for residents to view their own town or region as highly attractive, however its relative attractiveness needs to be considered. Why are current house prices so low? Why have people not moved to the area and created higher demand? Why are other areas attracting people despite having higher prices?

Following on from these questions, the scenario of Stawell becoming a FIFO hub can be explored along with the implications for retaining or attracting population. In the first instance, the expansion of FIFO would provide alternative work opportunities for local residents and that could lessen out-migration following closure of the local mine (assuming that retrenched workers choose the FIFO alternative). As a FIFO hub, the town could attract a higher number of people to use the airport facility, but many of these people may remain in their home communities outside of Stawell and simply drive to the airport to access the FIFO opportunity. While this can have some peripheral benefits to the Stawell economy through those people purchasing fuel or goods while they pass through town, it is only increasing the temporary population of the town not the resident population. Of course such people may decide that Stawell would be a good place to live and move there, but this may not result in a net gain to the region (demographically or economically) if they are moving from one local town to another. A more meaningful gain in population could come from being able to attract workers out of the larger cities to relocate in Stawell. This is a challenge which few regional towns have been able to achieve in recent decades.

Labour market flexibility

One of the problems faced by local government and local businesses in trying to establish FIFO arrangements has been the difficulty in identifying and gaining access to the right people within the mining company structures. Many mining companies hire staff via recruitment contract firms and this adds layers to an already complex system. Maintaining or increasing workforce 'flexibility' was seen as the key driver behind this type of arrangement, especially coming off the peak of the mining boom and seeking to lower costs.

> *[The mining companies are] remaining very flexible. The capital inflows into that sector are very tight at the moment. I think that that's the main barrier for us. So we've got the skills, we've got the assets and we've got the desire. It's really about finding the need outside of our communities for our skills or for our assets. Really all you'd need is just a couple of mines that require the specialist skills and they can't source them for whatever reason through the normal channels, then we're off.* [Interview 5 cited in DTPLI, 2013]

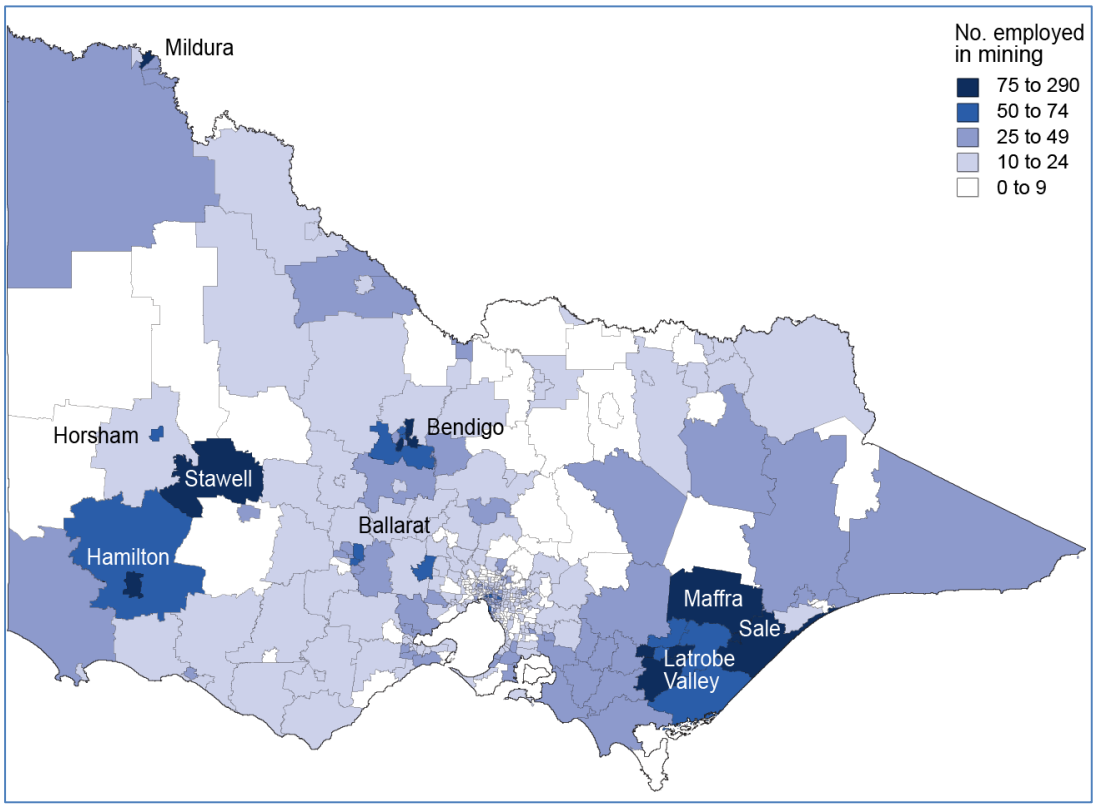
While the economic efficiency of workforce flexibility makes sense from a purely financial point of view, it can be at odds with the objectives of stability and sustainability that FIFO source communities are seeking.

> *It's almost that they just want available staff, and major flexibility about being able to employ and drop, employ and drop. One of the fellows applied for a job through one of these contractors and he was going to be employed for a three-week block at a particular mine and he*

> *was saying, "am I now contracted to that mine?" "No, no, you'll go anywhere we tell you - you could be working in the Pilbara or Queensland or Tassie or whatever".* [Interview 5 cited in DTPLI, 2013]

Another side to the issue of labour market flexibility concerns the location of FIFO source hubs. The use of capital cities as sources of labour has advantages for mining companies in terms of the size of the labour supply and the existing aviation infrastructure. The effects of scale enable flexibility around numbers, rosters and flight destinations. While Stawell may not be able to compete with the scale of Melbourne, it does have the advantage of being in a region with access to many people with mining-related skills. Figure 3 shows the location of workers within the mining sector and concentrations can be seen around Ballarat, Bendigo, Horsham, Mildura and Stawell.

Figure 3: Numbers Employed in Mining by Place of Usual Residence, SA2 Geography, 2011



Source: ABS Census 2011 using Table Builder.

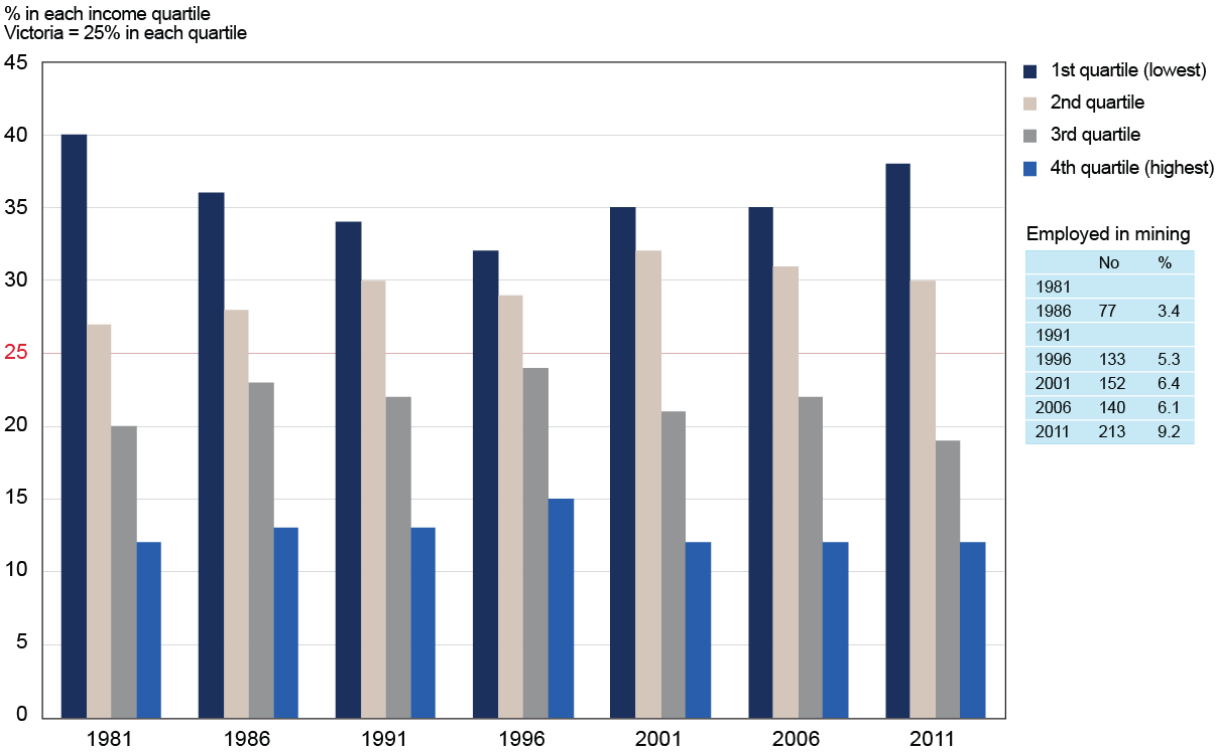
Data from the Stawell Gold Mine and from the interviews indicates that many workers are already commuting across this region to access local or interstate employment. It is therefore not surprising that many in Stawell feel they have a central advantage for servicing this wider region as a FIFO source hub.

Another aspect of the mining labour force in the region relates to skills. In this respect, Stawell regards itself as having a unique advantage because of the town's long history in mining. Despite the existing skills base in Stawell, this may only be a strategic advantage if those skills are competitive (up to date) and transferable to a range of alternative mining opportunities. Longevity of mining workers in a single job can create specialisation but may also constrain the opportunity to move to other types or scales of operation. For example,

underground mining operations at Stawell are at a much smaller scale than many mines elsewhere in Australia.

Training initiatives in Stawell have been strong in recent years and this is enabling many workers to gain, retain or expand their skills base. However, the expansion of mining employment in Stawell during the 2000s did not have very much impact on local wages within the sector (figure 4). One explanation for the lower wages may be that the Stawell rosters are relatively short – 4 days on 4 days off, therefore workers are not receiving as much as they would with longer rosters. However, the lack of movement in high income quartiles in the town suggests that the mining 'boom' of the 2000s may not have had any substantial impact on the town. Given the evidence of intra-community tensions associated with a perceived increase in income inequity in Busselton as a result of expanded FIFO opportunities, the question of whether increasing FIFO opportunities would change the wealth profile of the town to a substantial degree is worthy of further discussion and analysis.

Figure 4: Income and Employment in Mining Sector, Stawell township, 1981 to 2011

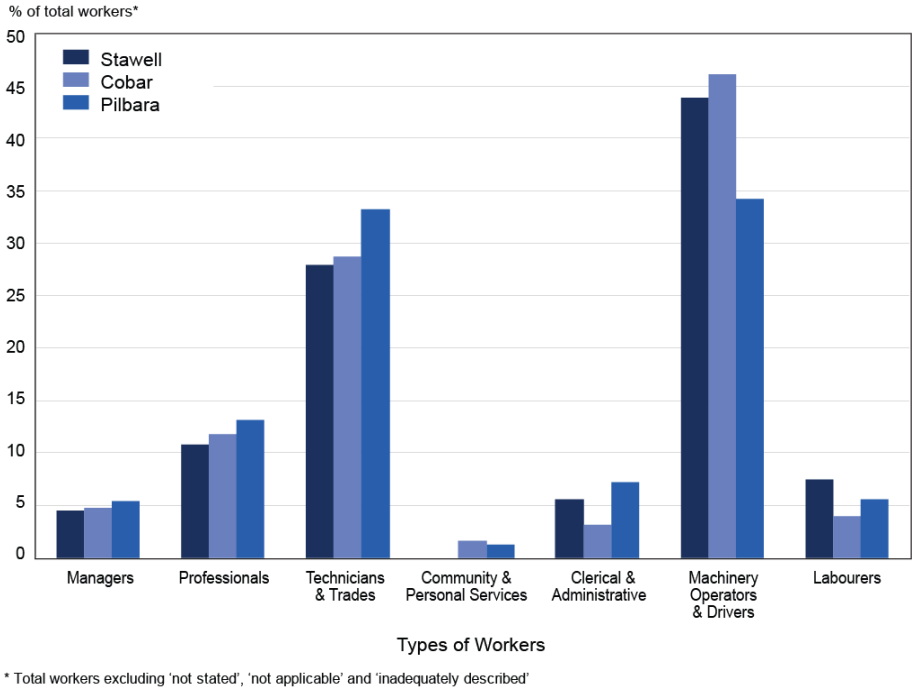


Source: DPCD 2013, *Towns in Time*.

Another factor in Stawell's lower income profile may be that the local workforce has a different professional profile than mining work forces in other parts of Australia like the Pilbara (figure 5).

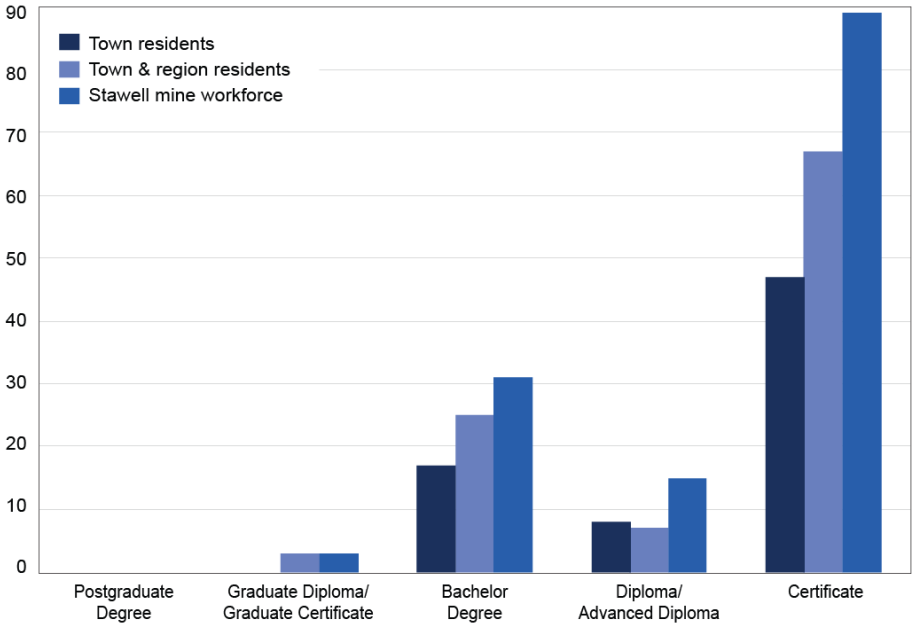
Mining jobs in engineering or management require higher level tertiary skills. As the mining industry becomes more knowledge intensive, such qualifications are likely to become increasingly important. While other nations may be able to compete on low labour costs, Australia's global competitiveness has increasingly relied on capital-intensive operations and increasing productivity levels. Primary industry sectors like mining or agriculture have an increasing need for knowledge based skills and tertiary education to boost earning potential and competitiveness.

Figure 5: Occupational Profile of Mining Sector Workers by Place of Work, Stawell, Cobar and Pilbara, SA2 geography, 2011



Source: ABS Census 2011, using TableBuilder.

Figure 6: Higher Education Qualifications of Stawell Mining Workforce, Township (UCL), Region (SA2) and Place of Work, 2011



Source: ABS Census 2011, using TableBuilder

While the workforce at the Stawell goldmine show a level of qualification comparable or better to some other mining regions, a detailed examination of the resident location of this workforce reveals that those living in the town of Stawell have lower levels of higher education that the Stawell mining workforce overall (figure 6). This suggests that those with higher education levels are living outside the town – either in the broader district or further afield in regional centres.

The Stawell community is proud of its mining heritage. Local workers who have worked in the mine for a number of decades are regarded as skilled and reliable workers. Nevertheless, remaining competitive does not just mean you have a set of skills or have had them for a long time – increasing education levels and exposure to global best practice through working in many locations is probably as important to enhancing the skills base of Stawell in the long run. Educational attainment is determined by access to suitable facilities but also to student aspirations – the desire to pursue education in the first place. Regional areas can be disadvantaged in a number of ways with barriers to aspiration and participation in ranging from poor school retention rates through to lack of role models or peer support (RPAC, 2013, pp. 29-30). FIFO can actually help in expanding the range of skills and experience open to local workers and this may actually prove to be as valuable as the training programs currently in place.

> *Fly in, fly out's good, I like fly in, fly out ... You meet new people, you learn new things.* [Interview 8 cited in DTPLI, 2013]
>
> *The work up here at Stawell Mine is so different to everywhere else in Australia ... I'm so glad I went somewhere else to a mine that actually works on ... Western Australian based rules.* [Interview 10 cited in DTPLI, 2013].

Companies and communities

Possibly the key hurdle identified by local government, contractors and workers alike is the difficulty in negotiating with large mining companies. To make an expanded FIFO arrangement out of Stawell work there needs to be more jobs offered at individual mining sites with all workers flying from Stawell starting and ending shifts on the same roster. Flying workers out of larger city centres affords companies greater flexibility in that they provide flights for the beginning and end of shifts from one central location and all workers regardless of where they may live are obliged to make their own way to the airport. This means shift allocation is set in stone and the obligation of flexibility is on the worker to attend his/her own shift.

Respondents were aware of the difficulty in convincing mining companies to tailor shift allocations around particular individuals who may be coming to work from Stawell on limited airline services. This is not to say it couldn't be done but this area was recognised as a place where government negotiation power could be useful.

Another constraining factor in developing a FIFO hub at Stawell is the "Point of Hire" arrangements used by mining companies. Recruitment is based on a particular source location such as a capital city and it is from this point that FIFO arrangements will be recognised in terms of travel costs, insurance and so forth. This means that many FIFO workers living in regional areas have to travel to the point of hire location first. This is the reason that many FIFO workers in the Stawell region are responsible for this first phase of an interstate commute.

Wealth generation

This perception of the Stawell economy being more prosperous with FIFO is worth considering more critically. Clearly, the retention of workers after retrenchment and their

ability to retain access to mining sector employment means that income will not be lost to the town through out-migration or a drop in wage levels.

There is little doubt that a worker moving from a non-mining sector job into a mining sector job is likely to have an increase in wages. However, if Stawell residents are moving from a job at the local mine to one in another location, the wages may not be so much higher, especially if they need to undertake retraining, or simply readjustment to a new workplace What would be needed to significantly alter the economy of Stawell would be an increase in numbers attracted to the town (for example, if the FIFO hub idea expanded beyond the numbers needing to be re-employed from the Stawell Gold Mine). Any additional workers attracted to the area may simply represent a movement of existing mine sector workers within the region. Evidence from the interviews suggests that the central and western parts of Victoria have a mobile mining workforce who access job opportunities locally, regionally or interstate. Unless these workers are tapping into more highly paid levels of the mining sector, then the overall wealth of the region may not be changing that much.

A comparison of income among the mining work force of Stawell and the Pilbara highlights both a positive and negative aspect of the local workforce. The lower wage profile of Stawell workers may suggest that their skills lie in lower paid mining jobs. Alternatively, the difference may be related more to the different types of roster arrangements involved in the more distant regions of Australia. Stawell is rather unusual in terms of having short roster arrangements – 4 days on and 4 days off. While this is a very 'family friendly' roster arrangement and one attractive to local farmers who are employed at the mine, it limits the income earning potential of individuals. Moving to higher ends of the spectrum may require higher education levels (into management for example) or a shift to less popular rosters (which can have higher individual and social costs). Nevertheless the Busselton case study has highlighted that, during the boom of the past decade at least, mining companies have been prepared to pay premiums for FIFO and DIDO workers that reflect, on a sliding scale, the number of consecutive12 hour shifts regularly worked per extended work, and the number of days away from home per 'swing'. Alternatively, Stawell could aim to attract new mining workers into the area from further afield – Melbourne, interstate or overseas. This would involve a much wider strategy of amenity-based migration to capture highly skilled and highly paid FIFO workers.

6. CONCLUSION

The mobility of labour is an important element within regional economic theory and policy. Such mobility is a mechanism for a flexible and efficient economic system in which workers move to areas of greatest employment and or wage level (Productivity Commission, 2013, p. 1). Reality is rarely as simple as this. In fact humans tend to value non-economic factors in their choice of residence – place association, family and friend networks and physical aesthetics – which can prove to be strong anchors which inhibit relocation. For this reason, mobility through commuting may be substituted for mobility through permanent migration. While having its own costs, such mobility has the advantage of allowing workers to remain in a location even after their local job opportunities may have diminished, for example through economic restructuring or industry closure (McKenzie, 2012, p. 177-79).

The case study of Stawell represents an interesting extension of this preference for commuting over out-migration in response to an impending industry closure. The opportunities presented through long distance commuting – flying in particular – are being pursued with the aim of retaining the local population even in the face of local employment losses. In an economic sense this may simply be seen as a substitution of one form of mobility

for another. Nevertheless, it also highlights the importance of social factors in community wellbeing – the desire to maintain and support a local community which has its own networks and support systems – social capital.

The experience of Busselton which has developed into a FIFO hub is, in many ways, the future that Stawell is seeking. Hence, the opportunity to develop insights through these case studies is critical so that lessons can be passed on and pitfalls avoided. Long distance commuting presents many challenges for those involved: separation for periods of time, potential loneliness and isolation and disruption to prior patterns of work and leisure. As seen in Busselton, there are potential community-based tensions that need to be managed. Nevertheless, both case studies showed that many 'regular' jobs present difficulties through long work shifts or deregulated working hours. Individuals and couples respond differently to such challenges and, while long distance commuting may place destructive levels of stress on some relationships, it tends to exacerbate issues rather than create them on its own. The FIFO lifestyle may suit some people better at some stages of life rather than others, although there are many exceptions here as well. Perhaps one of the most important factors is the detailed nature of the work arrangements. Shorter block rosters such as 8 days on, 6 days off were reported as much more family friendly than arrangements with much longer periods of absence.

A factor which appears to be important is whether the individual or family enter the FIFO lifestyle fully informed or aware of what it entails. In this respect, the fact that Stawell has a number of people involved in FIFO and DIDO appears to have the benefit of first-hand information being available to those who may be considering the lifestyle. Additional support from local Council and regional health care organisations have formalised this process to some degree through the establishment of regular support and information meetings.

Stawell has a number of factors which make it suitable for future FIFO expansion. It has an airport capable of running charter flights and a local aviation company willing to expand to meet demand. The local workforce has been involved in the mining industry for decades and the workforce is therefore 'job ready' for many other mining opportunities across Australia. Support for the concept has been gained across various sectors of the local community – business government and local workers. The town itself is an attractive place to live being near the Grampians and being within an hour's drive from regional centres like Horsham, Ballarat and Bendigo.

The expansion of FIFO also faces challenges to be fully realised. FIFO hubs often attract population growth which can also be challenging. A preparedness to accept new people into the community and perhaps experience pressure on housing and services requires careful civic management and leadership. Furthermore, Stawell is not the only town in Australia vying to be a FIFO source hub. Town representatives have struggled to fully engage with mining companies elsewhere in Australia as most employ recruitment agencies to deal with staffing. Furthermore, the tendency for mining jobs to be filled via 'word of mouth' can make it difficult for individuals to break into the industry. Research undertaken by Rio Tinto and BHP show that approximately 80 per cent of their recruitment is by word of mouth (Haslam-McKenzie personal communication 2013). Resources in towns like Stawell are often limited or stretched thinly so the capacity to pursue interstate opportunities, sell the benefits of Stawell and coordinate the implementation of a FIFO strategy is compromised.

At a more subtle level, Stawell faces some competitive challenges. While the Stawell Gold Mine workforce has a range of mining skills and education, the overall profile of occupation and tertiary qualifications appears lower than other mining regions in Australia. With Australian mining becoming more mechanised it is likely that future jobs in the industry (and

certainly the higher paid jobs) will be those requiring higher levels of formal education, for example engineering or electronics, rather than being based on manual labour. FIFO alone will not transform the future education levels of the Stawell work force although it will enable exposure of local workers to a more diverse range of mining opportunities. In this regard, it may influence the aspirations of local workers and their families and enable much greater engagement with a globalised mining sector, thus generating future economic opportunities and pathways.

DISCLAIMER

The views expressed in this paper are those of the author and should not be regarded as representing the views of the Victorian Government nor the Department of Transport, Planning and Local Infrastructure.

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Digital Divide Research in Australia: A Critical Review

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ABSTRACT

This article makes an inventory of digital divide research in Australia over the past two decades. The major weaknesses of Australian digital divide literature are the absence of an application of digital divide theory, conceptual definition, interdisciplinary approach, longitudinal research and data limitations. Most of the studies used qualitative micro data involving small towns and cities. This makes it difficult to generalize the findings. No macro data have ever been used to study digital divide in Australia. Also, almost all the studies focused only on identifying the factors that contribute to digital divide. Studies investigating the impacts of digital divide on Australian economy, society and politics have been rare. The results of this review further reveal that digital divide still exists in Australia basically with respect to four factors; lower income, absence of tertiary education, lack of internet skills and race. The indigenous people in Australia are still a disadvantaged class in terms of access to and use of internet.

1. INTRODUCTION

Rapid expansion of internet has been transforming Australian economy over the last 10 years and is likely to play an even greater role in the daily lives and businesses as Australia positions itself to become a leading digital economy. The direct contribution of the internet to the Australian economy is worth approximately $50 billion or 3.6 per cent of Australian Gross Domestic Product (GDP) in 2010 (Deloitte Access Economics). The internet is a catalyst for the success of small and medium-sized enterprises (Deloitte Access Economics).

However, the expansion of internet use resulted in its uneven spread globally, regionally and within regions leading to a form of social inequality - a phenomenon popularly described as the 'digital divide'. The term 'digital divide' has been used variously to signify a range of inequities on a global, national and community level - whether social, economic and political or in terms of access to infrastructure. Early iterations of the concept used the term to describe disparities in the access of the internet and new telecommunications services across different social groups.

The OECD (2001) defines digital divide as the gap between individuals, households, businesses and geographic areas at different socio economic levels with regard to both their opportunities to access Information and Communication Technologies (ICTs) and to their use of the internet for a wide variety of activities (OECD, 2001). A number of studies (Räsänen, 2006) argue that the digital divide is an indication of serious and more critical divides-social, economic, educational and developmental. The International Telecommunications Union

(ITU) widened the concept of digital divide proposing that it must also be understood in terms of use, reflecting differences between its users and non-users and differences between the quality and intensity of use among ICT users. A 2007 report by the OECD repositioned the focus from one of a 'digital access divide' to a 'digital use divide'. However, in the second decade of the 21st century, OECD (2013) redefines digital divide as the gap between individuals, households, businesses and geographic areas at different socio economic levels with regard to both their opportunities to access ICTs and to the inequity of the use of the internet for a wide variety of activities (OECD, 2013).

Most of the literatures on digital divide support its existence in both developed and developing countries. It is feared that digital divide is even in the danger of widening in Australia (Bowles, 2012). Studies on digital divide in Australian context are relatively scarce. The research started to emerge since the late 1990's. Almost all studies since the 1990s till date indicate the presence of digital divide in Australia and the Australian government has been pursuing various policies to bridge this divide since mid-1990s. One of the priorities of the National Broadband Network (NBN), the largest ever infrastructure project currently being implemented in Australia is to reduce digital divide in the regional and rural Australia to exploit the maximum potential of internet in Australian economy. Therefore, this review work is important for digital divide researchers as well as for the Australian policy makers to understand the present digital divide scenario better about the digital landscape of Australia. It is expected to identify the gaps in the research providing further direction that will enable Australian government and policy makers and also the NBN better address this issue.

This study presents a brief overview of the studies on digital divide in the Australian context. The rest of the paper is structured as follows: section 2 provides a brief overview of literature on global digital divide while section 3 is the main contribution of this work which is devoted to the discussion on digital divide literature in the Australian context. Section 4 presents a discussion on the potential of internet social capital to reduce digital divide highlighting the digital divide-social capital literature in Australia. The study concludes in section 5 with a brief discussion on the achievements and shortcomings of digital divide studies in the Australian context.

2. INTERNET USAGE AND GLOBAL DIGITAL DIVIDE

As internet usage started expanding, its uneven distribution caused initially digital divide which was defined as a gap between those who have access to the internet and those who do not - the so called first level digital divide. As internet became more and more accessible, researchers have reconceptualized this concept by focusing on the inequities of the use of the internet - the so called second level digital divide. Hargittai (2002) pointed to the importance of skill as a 'second level digital divide'. Palfrey and Gasser (2008) argues that the main issue is not just technology access but digital literacy. Recent studies (Borisov and Serban, 2013; Pedrozo, 2013) also support this argument. Borisov and Serban (2013) caution that disparity in the ability to use internet between those who are experienced users of internet and those who lack skills to use it or are new users, have created another divide what he terms as second digital divide.

Pedrozo (2013) argues that lack of computer literacy, cultural and economic factors affect disadvantaged youth in a more radical way and may restrict even more their chances to participate in the increasingly demanding and globalized labor markets. The third level of digital divide was linked with the knowledge gap in some researches (Van Dijk and Hacker, 2003; Wei and Zhang, 2006). Another divide – the so called 'net generation divide' – was voiced by some researches (Toledo, 2007; Waycott *et al*, 2010). It is the divide between the

"digital natives" (young people grown up with computers and the internet) and the "digital immigrants" (older people showing less technological affinity and literacy than their younger counterparts).

Digital divide adds a fundamental component to existing sources of inequality in a complex interaction as seen in poor countries where deprivation, illiteracy and basic needs such as food, health care, housing and wellbeing are unattended. These factors create barriers and account for differences in internet access and use in developing countries and within disadvantaged groups in developed countries (Neumayer *et al*, 2010; Newman *et al*, 2010).

A good number of recent studies dealt with quantifying the digital divide by means of composite indicators or indices. These indices proved to be very useful tool for understanding the multi-dimensionality across countries (Vicente and Lopez, 2011). In this context, several authors have successfully incorporated the various dimensions of digital development into an index by means of factor analysis. Using this technique, the ITU launched several indices such as Digital Opportunity Index and ICT Development Index to measure digital divide (for an explanation of ITU indices and others, see World Economic Forum, 2012).

Other related works address the composite index approach which seems to be the most frequent, for example, Hanafizadeh *et al*. (2009) propose a cross country index on ICT infrastructure and access. Barja and Gigler (2007) apply the notion of digital poverty line particularly for the Latin American context. Also there are some works that use simpler indexes (Polat, 2012). However, Bruno *et al*. (2011) criticize a number of current indexes for digital divide measurement and propose alternatives using the multivariate approach. Employing this approach, Iliadis and Paravantis (2011) present a cross country empirical analysis of the digital divide.

At the macro level, the main causes of the digital divide include the wealth of a country, availability of infrastructure, costs of computers and other accessories, digital literacy, education system in the school (Binde, 2005). At the micro level, the influential factors include socio-cultural-economic variables such as location, race, gender, age, income levels, educational background, social support (mainly from school and parents) and variation of internet use.

Empirical research shows that the most powerful factor causing disparities in ICT adoption is economic wealth both between countries, regions and among individuals (Li and Ranieri, 2013, Vicente and Lopez, 2011, Weber and Kauffman, 2011). Chinn and Farlie (2010) find that per capita income is the single largest factor explaining digital divide. Gender is also found as a factor that causes digital divide (Papastergiou and Solomonodou, 2005). They show that females have less frequency of using computer than their male counter parts. Billon *et al*. (2009) find that the regional proportion of population with tertiary studies is positively correlated with internet and e-commerce adoption.

Population size and its socio-demographic features also explain the digital divide across territories. It is therefore expected that population having more people with tertiary education is positively correlated with internet diffusion and e-commerce adoption (Vincente and Lopez, 2011). Schleife (2010) finds a negative relationship between the proportion of foreigners to the total population in a country and the local rate of internet users.

A few previous studies consider the determinants of digital divide within countries. For example, over the period of 1990 to 1997 for 44 countries, Dasgupta *et al*. (2005) found that digital divide exists due to disparity in the availability of mainline telephones not for internet intensity, and income differentials and urbanization mattered. Using data for 118 countries from 1997 to 2001, Guillen and Suarez (2005) found that the global digital divide as

measured by cross national differences in internet use was the consequence of countries' economic, regulatory and socio-political characteristics as well as their evolution over time. Chinn and Fairlie (2007) examined 161 countries over the period of 1999-2001. Their studies showed that the global digital divide is mainly accounted for by income differentials. Kyriakidou *et al*. (2011) finds the existence of digital divide in 27 European countries where many of the countries are OECD countries.

Internet usage also generates network effect. The term "network effect" comprises social influence exerted by the user network that surrounds current non-users. Agarwal *et al*. (2009) state that the existence of such social networks can further increase the internet adoption probability. Whatacre and Mills (2007) confirm that network externality plays a role to explain ICT urban-rural divide. Schleife (2010) corroborates this finding of the existence of such network effects. The network effect is identified as an important factor to accelerate diffusion in another recent study (Andres *et al*. 2010). Also the speed of access to broadband is a powerful factor to affect internet maturity level. A very recent study by Evans *et al*. (2013) finds that the willingness of people's migration from current ICT connections to faster network may be a factor to explain digital divide. Another study by Shim et al. (2013) suggests that online social network services supported by rural ICT policy relate to social capital. Another study (Borisov and Serban, 2013) cautions that disparity in the ability to use internet between those who are experienced users of internet and those who lack skills to use it or are new users, have created another divide what he terms as 'second digital divide'.

From the above review of literature, it is evident that global digital divide exists and that it has not declined (Zhang, 2013). In summary, the cross country studies dominate the literature on internet diffusion and digital divide.

3. INTERNET USAGE AND DIGITAL DIVIDE RESEARCH IN AUSTRALIA

The Australian Bureau of Statistics (ABS) has monitored technology access and use in Australia since 1996. An Australian government study (Department of Communication, 2003) highlighted the issues of the digital divide for the first time mentioning the lack of research and evaluation of perceived gaps in the digital divide and of funded initiatives attempting to address this issue. Despite this disappointment from the government long ago regarding research on this crucial issue, the literature didn't grow proportionately.

Most recent studies on internet usage and digital divide in Australia indicate that despite significant increase in the level of internet usage, digital divide resulting from various factors such as lack of tertiary education, old age, lack of affordability and from being in the indigenous community, persists. It is argued that social inclusion through social interaction at the community level could play a vital role to narrow digital divide at the regional level (Broadbent and Papadopoulos, 2013).

Rennie *et al*. (2013) in a recent study in some indigenous communities known as outstation finds the evidence that Indigenous Australians living in remote Australia are unlikely to have access to the internet at home. They identified money including affordability, priority and demand sharing as the major perceived barrier. They further mentioned other barriers to internet use as limited English literacy, security of hardware and power supply. The study also recommends education, online services and entertainment space for the uptake of internet. Charleson (2012) argues that enhancing empowerment and social capital through internet network for those already burdened with disadvantage and marginalization could be a potential mean to narrow the current digital divide in Australia.

Bowles (2012) indicate that digital divide in Australia is in the danger of widening. The same author in another study (Bowles, 2011) identifies income, education, age and ethnical diversity as the key reasons for the current digital divide in Australia. Lee (2011) in a recent study highlights the presence of digital divide resulting from inequity in the ability to use internet (the so called, second level digital divide) in Australia and focus on Australian government's programs and policies aimed to address digital divide. The study also focuses on the government facilitated educational and informational policies designed to reduce the knowledge digital divide. It recommends further educational measures to enhance peoples' ability to make use of available technology and reap the maximum benefits from the ongoing roll out of NBN.

Almost all earlier studies and reports of the Australian Bureau of Statistics (ABS) indicated the presence of digital divide in Australia. Atkinson *et al*. (2008) while exploring digital divide in Albury, a regional city in Western Australia, found the presence of digital divide in relation to income and different city locations. The study also identifies age, education and income levels as the key factors that contribute to digital divide in the city. Notley and Foth (2008) discussed how network society thesis extends the information/knowledge society credo by providing a way to understand and value new forms of internet participation. They further argued that within the network society thesis, social capital and social inclusion can be understood as two frameworks that can be used by policymakers to define the social benefits of internet participation and focused on funding and initiatives on ensuring that these benefits are strengthened and more equally dispersed.

Data from the Australian Bureau of Statistics (ABS, 2007) indicated that households with particular characteristics are less likely to be connected to a computer and/or the internet. These characteristics include: lower household incomes, number of children under 15 years of age and located whether in non-metropolitan or remote areas of Australia. Willis and Tranter (2006) assessed inequalities in internet use through analysis of national survey data of Australia over the period 1998-2003 and explored persisting barriers to internet diffusion in Australia. They argued that although the internet has become more accessible to all social categories, household income, age, education and occupational class still remain the key dimensions for digital divide. Byrne et al. (2006) uses ABS data from Multipurpose Household Survey (MPHS) and found that similar percentage of men and women use internet indicating closure of the gender gap in Australia.

Feldman (2004) found that poor English language skills affect internet usage. He argued that those with English language background were more likely to find internet use easy than those without, as the internet features and software were mostly available in English. Riley (2004) found that females in Australia use the internet less often than their male counterparts. This finding was supported by an ABS report later (ABS, 2007) which confirmed that 53 percent of Australian males use the internet as against 47 percent female internet users. Gibson (2003) in a study warned that despite increase in computer usage and internet access, digital divide was not decreasing in Australia until the time of the study. He identified a number of factors as contributing to the digital divide in Australia such as, income, education, age, location, disability, opinion, gender and culture. Curtin (2001) suggested that the level of education is a key factor in predicting internet access in Australia. Keller (1995) indicated that education and income are the most likely determinants of society's access to internet.

From the above review it is evident that digital divide research in Australia is scarce. The key factors contributing towards the current digital disparity in Australia are income, education, age, ethnical diversity, gender and language background. Therefore, more and more attention is required for digital divide research so as to better address this issue. More in-depth

investigation of digital divide with current data is of paramount importance in the current Australian context.

3.1 Data and methodologies used in digital divide studies in Australia

Most of the digital divide studies in Australian context used qualitative micro data involving small towns, cities and communities. Some of the studies used both qualitative and quantitative data to study the determinants of digital divide in regional Australia. Quantitative data were obtained by questionnaire survey while qualitative data were collected from interview and focus group discussions. Quantitative data were analysed mostly by multivariate regression analysis, logistic regression and factor analysis. No digital divide index provided ITU or by other recognized sources has so far been used to measure it in any Australian study. Some of the researches used data published by Australian Bureau of Statistics and Deloitte Access Economics.

One of the major weaknesses in Australian digital divide studies is that no macro data have so far been used to study digital divide. The methodologies used in Australian digital divide research suffer from serious setbacks in that no sound theoretical framework, no standard measurement of digital divide have been developed and used to ensure significant outcomes from research in the area.

3.2 Digital divide policy in Australia: From networking the nation (NTN) to the national broadband network (NBN)

The first significant national digital divide policy intervention in Australia was announced by the Coalition government in 1996. Networking the Nation (NTN) was aspired to enhance telecommunications infrastructure and services; increase access to, and promote use of services available through telecommunications network and reduce disparities in access to such services and facilities. However, this initiative was dubbed as an inadequate response to the Australian digital divide that did not operate from an information need assessment (Van Vuuren, 2007). NTN was followed by the 2004 Co-ordinated communication infrastructure fund to encourage health, education and other sectors of public interest to maximize opportunities for improved broadband access and services in rural, regional and remote Australia. In addition, two other initiatives: *Communications Fund* for future-proof telecommunications services in rural, regional and remote Australia and *Connect Australia* to roll out broadband to people living in regional, rural and remote areas, extend mobile phone coverage, build new regional communications networks and set up telecommunications services for remote Indigenous communities (Coonan, 2005). Two more initiatives were taken to address the infrastructure needs of the indigenous communities: The 2002 Telecommunications action plan for remote indigenous communities and the 2006 Backing Indigenous ability to redress low level of telecommunications access and access quality in Indigenous communities.

The new Labor government in 2007 announced a broadband future policy for Australia. The policy aimed to build an optical fibre network that would target 98 per cent of Australian households and offer speeds over 40 times greater than the current average (Hoy, 2007). The only other policy with a digital divide focused only on the issue of technology access. However it failed to show how it will ensure the equitable benefits of use of internet.

In 2009, the government announced the largest ever infrastructure project – the $47 billion National Broadband Network (NBN). The construction of the NBN is now underway and its roll out will continue until 2018. It provides an opportunity to address digital divide and to empower people to effectively use new technologies as they become available.

With the change in the government recently, although NBN is not expected to disappear, the implementation pattern is expected to change. The coalition policy on the NBN is expected to see FTTP (Fiber-To-The-Premises) deployed to only twenty-two percent as against ninety-three percent targeted by the former Labor government. Seventy-one percent is expected to be covered by the FTTN (Fiber-To-The-Node) technology where fiber will be extended to high nodes. The remainder of the distance will be covered by Telstra's copper network. Although coalitions target is to downsize the cost of the project, this may have negative cost implications for the NBN users. Experts fear that this might even deteriorate the digital divide especially in regional Australia where cost is still a vital factor to adopt internet.

No in-depth research has so far been conducted to investigate the effectiveness of various digital divide policy the Australian government has been pursuing since the mid-90s and one of the most difficult things about assessing the impact of Australian digital divide policy is that both policies and initiatives have been implemented by local, state and national governments as well as the third sector organizations. The third sector organizations and research bodies are not included in the Online Communications Council (OCC) resulting in lack of coordination. It is understandable that without a strategic body and framework that connect local, state and national digital divide policies and practices, the goal to address digital divide will be undermined. More and more rigorous research works on the digital divide policies and its effectiveness will enable Australia to succeed in its bid to lead in the race for digital future.

4. DIGITAL DIVIDE AND SOCIAL CAPITAL IN AUSTRALIA

Recent data confirms that the rural and remote areas in Australia are in a disadvantaged position in terms of various socioeconomic indicators as compared to its urban counterparts (ABS, 2013a). It is argued that social inclusion through social interaction at the community level could play a vital role to narrow digital divide at the regional level (Broadbent and Papadopoulos, 2013). Charleson (2012) suggests that enhancing empowerment and social capital through internet network for those already burdened with disadvantage and marginalization could be a potential mean to narrow the current digital divide in Australia.

Digital divide is more than the provision of access to technology. Different demographics, ICT needs, capabilities, and skills need to be better understood if they are to be aligned with realistic social policy goals (Notley and Foth, 2008). Internet use increasingly enhances the opportunities for social support. It has the potential to generate social capital which according to Putnam (1993, p. 167) is defined as "the features of social organization such as trust, norms and networks that can improve the efficiency of society by facilitating coordinated actions".

Bourdieu (1986, p. 39) defines social capital as "an attribute of an individual in a social context. One can acquire social capital through purposeful actions and can transform social capital into conventional economic gains". Internet usage generates social capital through networks of relations between different people and different communities (Lippert and Spagnolo, 2011). Social norms are a result of the joint evolution of social networks and specific patterns of economic exchanges.

In Australia through digital inclusion of the disadvantaged people in rural and regional areas and a successful digital divide policy must include social capital framework in its agenda (Notley and Foth, 2008). Internet users have reported increasing positive impacts of the internet use in areas such as hobbies and interests, shopping, work, employment and health care information (Doong and Ho, 2012). There has been significant increase in the use of various social network sites (SNSs) which affect our social, political and economic lives

(Ferreira-Lopez et al., 2012). It is suggested (Kyujin Shim, 2013) that online social network services supported by rural ICT policy relate to social capital.

A few earlier studies addressed the potential of internet to generate social capital in Australia within a limited scale. Only a few studies (Meredyth *et al*, 2004; Fernback 2005; Foth and Podkalicka, 2007) have considered this issue and conclude that ICT use can have a positive impact on an individual's social inclusion and on a community's collective social capital. However, most of these studies were descriptive and dated with regards to policy relevance. Selwyn and Facer (2007) argue that ICT lies at the heart of most of the activities that are seen to constitute 'social inclusion' – from playing an active role in one's neighborhood and community to maintaining one's personal finances.

Simpson (2009) emphasizes the interplay between physical infrastructure, soft technologies and social capital for successful implementation, widespread uptake, greater social inclusion and the sustainability of ICT initiatives. Servon (2002) perceives technology as a tool of inclusion or exclusion. She notes that technology includes certain classes of people while excluding others. DiMaggio *et al*. (2001) argue that internet builds social capital by enhancing the effectiveness of community-level voluntary associations.

These findings lead to a discussion to what is known as 'network society thesis' (Barney, 2004; Castells, 2000). The central idea of 'network society thesis' is that contemporary social, political and economic practices, institutions and relationships are organized through and around network structures (Barney, 2004; Castells, 2000). The 'network society thesis' is a useful tool to understand new forms of internet use because it connects with and then extends the concept of the information society. The arrival of the internet technology resulted in a significant expansion of network communication (Wellman, 2001; Castells, 2001).

There are both positive and negative effects of network society (Barney, 2004). Therefore it is too early to claim that ICT-mediated network made any substantial contribution towards how internet is transforming the way society functions today (Deloitte Access Economics, 2011). It is within the 'network society thesis' framework that social inclusion and social capital offer policy frameworks through which the current digital divide could be bridged addressing the online needs of specific disadvantaged groups and ensuring that all citizens with online opportunities lead to the formation of social, cultural and economic capital.

There are at least three reasons to suspect that web-mediated social participation can work as an effective strategy to protect the relational sphere of individuals' lives from the pressure of time (Antoci *et al*, 2012). First, it is less exposed to the deterioration of the social environment that physically surrounds individuals. Second, it is less time-consuming than face-to-face interaction and thus saves time for social participation. Third, online interactions contribute to the accumulation of internet social capital. A salient feature of this capital is that it allows asynchronous social interactions; one can benefit from another's participation through the act of communication a message or posting a photo even when the person who did this is offline. Internet social capital also benefits internet non-users by the information spill-over.

5. ACHIEVEMENTS AND SHORTCOMINGS OF DIGITAL DIVIDE RESEARCH IN AUSTRALIA

A number of digital divide studies in Australian context started emerging since early 1990s. Ever since, the literature grew but not up to the expected speed. However, most of the researches on Australian digital divide throughout 2000 mainly focused on the factors that contribute towards the disparity in internet usage. Through these works, it was possible to

know people's perception about the internet, its access, availability and affordability. It was revealed through these works that Australia suffers from the problem of digital divide especially in the rural and regional areas. This prompted the National Broadband Network (NBN) to target facilitating broadband access to rural and regional Australia at an affordable cost as one of its priority agendas.

The major weakness of current Australian digital divide research is the lack of conceptual elaboration and definition of digital divide. Even the most basic terms and concepts are still ill-defined. The most important seems to be the concept of access itself. There is still no operational definition of this term. What parameters are sufficient to phrase the term 'access' are not yet identified properly.

One of the other weaknesses in Australian digital divide studies is that no macro data have so far been used to study digital divide. The methodologies used in Australian digital divide research suffer from serious setbacks in that no sound theoretical framework, no standard measurement of digital divide have been used to ensure significant outcomes from research in the area. Most of the studies focused on identifying the factors that are responsible for the disparity in access to internet in early studies and in inequity of the use and other factors in recent studies. No digital divide index provided by ITU or by other recognized sources has so far been used to measure it in any Australian study.

To understand the type of digital divide that persists in Australia and to enhance the effectiveness of the NBN roll out, more and more rigorous researches involving not only small towns and cities but also at the national level in the area are vital. Researchers should pay more attention to develop a sound conceptual framework for the concept of digital divide itself and eliminate the confusion about other core issues to produce significant research outputs having important digital divide policy implications.

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Reproductive Health Beliefs and Perceptions among Slum Women in Bangladesh: Is this a Challenge to MDG5 Health Goal?

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ABSTRACT

This study investigates the reproductive health beliefs and perceptions among slum women and the reasons for accessing to traditional healers (TH) and spiritual healers (SH) for reproductive health services. Data was collected by means of in-depth one-to-one interviews with eight samples of Meherchondi, Rajshahi in Bangladesh, using snowball sampling technique. This study finds three dominant themes-a strong belief in TH, influence of family members, and traditional belief; and develops three frameworks including the belief themes and reasons, the belief-poverty framework, and factors influencing the decision to access rural health care clinics.

1. INTRODUCTION

Medical literature defines reproductive health as an organizational framework that incorporates maternal and child health programs, family planning, infertility, sexually transmitted diseases, post-natal infection and maternal and child health related concerns (Dudgeon and Inhorn, 2004). However, the present study adopts the World Health Organisation's (WHO) perspective that reproductive health refers to the rights of men and women to be informed and have access to safe, effective, affordable and acceptable methods of fertility regulation of their choice and the rights of access to appropriate health care services that will enable women to go safely through pregnancy and childbirth. In short, reproductive health addresses reproductive process, functions and systems at all stages of life (WHO, 2013). The World Bank's (WB) data shows that 31.5 per cent of total population in Bangladesh were living below the poverty line (WB, 2010), and therefore, attaining effective, affordable, safe and acceptable reproductive health is a critical concern to this cohort of the population.

Asian cultures embrace traditional healers (TH) for various treatments that may vary between general cold-cough and surgical operation. The rural women in Pakistan, for example, tend to access private informal health care services such as small hospitals, private nursing homes, and private clinics, and they get services from homeopaths, traditional physicians (hakeems), TH and spiritual healers (SH), herbalists and other non-qualified care providers such as medical technicians and pharmacy dispensers (Gadit, 2003; Khowaja, 2009). THs are also found to play a vital role in the Malaysian healthcare services and in treating cancer patients (Merriam and Muhamad, 2012). Similarly, the rural women in Bangladesh go to TH and SH for treatments like reproductive health and life threatening issues (Chowdhury, Islam,

Gulshan, and Chakraborty, 2007; Sibley *et al*, 2009). These women have many social, cultural and religious beliefs predicated upon the strong role that tradition plays in rural areas. These beliefs have significant influence on how individuals understand their own health related issues.

Although the adult literacy rate in Bangladesh has improved from 31 per cent in 1991 (Bhola, 2009) to 78.58 per cent in 2009 (BBS, 2011), rural people's basic abilities to read, write and sign a document do not necessarily equate with effective and basic health literacy. For example, a report by Caritas Australia (2011) found that the 85 per cent of Bangladeshi women who give birth at home and without the assistance of a trained birth attendant or midwives lack the knowledge needed to ensure protection of their own health and that of their children. The lack of health understanding has been further intensified by the fact that the rural women in Bangladesh often do not have an opportunity to access a specialist doctor. These considerations are challenging as Bangladesh is aiming to achieve the Millennium Development Goal (MDG) 5 target that aims for reducing the maternal mortality ratio of three-quarters by 2015. Although the use of semi-skilled birth attendants has improved this situation over the past fifteen years, it remains less than 20 per cent as of 2007 and is especially low among poor, uneducated rural women (Koblinsky *et al*, 2008).

The present study investigates beliefs and perceptions that are well entrenched among a particular slum women in Rajshahi district, in Bangladesh and the reasons why they access TH and SH for reproductive health care services. A recent study, in particular, stated that "it is important to understand the perspectives of the women who receive maternity care, in particular those coming from groups among which disadvantage is more common" (Jomeen and Redshaw, 2013, p. 293). This research uncovers the insights of the participants in regard to the multiple realities of their lives, and thus, provides a better understanding about Bangladeshi rural women's reproductive health seeking behaviour.

2. LITERATURE REVIEW

Reproductive health-related beliefs may include influences from cultural and traditional practices adopted during the birthing process, early care of the newborns (UNICEF, 2008), and even during pregnancy period. Such beliefs are more common in the remote rural areas, poorer geographic areas, and more prevalent among religiously observant segments (Siddiqi *et al*, 2007). Cultural beliefs, for example, can deter young women from accessing reproductive health services because they are reluctant to show their pregnant bodies (Hira *et al*, 1990). In addition, they are less likely to seek care from a doctor, nurse or midwife compared to urban women as they depend more on their husband's and in-law's decisions (Chowdhury *et al*, 2007).

In a similar note, Tarafder *et al*. (2012) conducted a case study of five participants on the aspects of the reproductive health care services of indigenous women in Bangladesh and found three main beliefs that include malevolent, in-door stay, and following in-laws and seniors. These beliefs are socio-cultural and context based. Tarafder *et al*. (2012) study also dealt same methodology of one-to-one interview with indigenous women where participants were not homogenous in terms of religion, education and income status like the present study. Tarafder *et al*. (2012) demonstrated a poverty framework that illustrates rural indigenous women are more likely to go to a traditional healer if – either socio-cultural context of beliefs' structure (SCCBS) or poverty is strong; or both are existent in a society. However, rural women are more likely to go to a professional health practitioner if – both SCCBS and the extent of poverty are low in a society.

One particular study, in this context, finds that husbands are important factors influencing positively or negatively, directly or indirectly, the reproductive health outcomes for women (Dudgeon and Inhorn, 2004). This echoes Chowdhury *et al*. (2007) findings that women, whose husbands were not concerned about pregnancy complications, were one and a half times less likely to seek care from a health professional.

Rural and poor women often strongly hold cultural beliefs, and trust TH and SH which, as demonstrated in the case of Pakistan, lead to a low rate of utilization of professional health services (Gadit, 2003). One study, in the Bangladesh context, found that about 46 per cent of women giving birth did not seek any care for postnatal excessive bleeding soon after their delivery, and 21.8 per cent went to a village doctor, a *kabiraaj*, or a practitioner of herbal medicine and has spiritual knowledge–and other traditional sources, for the treatment of postnatal excessive bleeding soon after their delivery (Chakraborty *et al*, 2003).

Women in many developing countries suffer in silence due to particular health-related beliefs and their practices. In the rural Bangladesh context, for example, the mother-in-law plays a major role in decisions relating to childbirth and care related to pregnancies and they decide how the delivery will take place; whether it is by a traditional birth attendant or by a health facilitator (Piet-Pelon *et al*, 1999).

Health-belief also depends on cultural and religious norms such as *Purdah* restrictions that can prevent Bangladeshi women seeking health care from outside their home for themselves and their children (Rashid *et al*, 2001). The traditional expectation of a mother's gender-based role in child bearing, and the deeply rooted cultural beliefs about health care options, affect her health status resulting in rural mothers being often less empowered in the decision-making regarding fertility, child spacing and family planning aspects (Sathar *et al*, 1988; Jejeebhoy and Sathar, 2001).

Although there is a lack of health care services and professional health care personnel in rural Bangladesh, the pre-existent cultural beliefs in rural Bangladesh lead rural women to believe that it is mostly the spirits that causes complications during pre-natal and post-natal stages. However, the current review does not adequately explain the extent, nature, scope, reason and consequence of these beliefs; nor is the current review adequate to explain reproductive health related beliefs of specific Bangladeshi slum communities.

In particular, there is an inadequate understanding in the current literature as to (a) What are the beliefs and perceptions of the slum women towards reproductive health? (b) Why are these beliefs and perceptions so formative of behavior within their context? (c) How do these beliefs and perceptions shape slum women's understanding and their subsequent decisions about their reproductive health and the services that are available? In addition, there is still inadequate evidence as to whether a qualitative research approach is a good suit to explore these research questions.

The current study explores the answers to these questions with the Slum women of the Meherchondi area in Rajshahi, Bangladesh; a community with a long and strong belief in traditional healing. Usually, the people living in the slum areas is separated from the main stream of society and often marginalized in various ways.

3. RESEARCH METHODOLOGY

This study used a qualitative research inquiry and employed a case study method. The main strength of qualitative research is that it yields data that provide depth and detail to create understanding of phenomena and lived experiences (Bowen, 2005, 2008). The current study employed a case study research method that has a wider range of implications in the real life

context (Desai and Potter, 2006). In particular, the reasons for applying a case study method are that: (a) this study deals with slum and vulnerable women who have hard core social, cultural and religious beliefs and have a tendency to avoid professional health care services; (b) this study is aiming to gather rich and quality data explaining the phenomena, reasons and contexts of their beliefs; and that (c) there is inadequate studies that consider a case study method within the qualitative research inquiry, and hence a case study research is appealing and contributing to the current literature.

The current study found eight women living in the slum areas in Rajshahi, using purposive and snowball sampling techniques (Schuler *et al*, 2002; Punch, 2005; Desai and Potter, 2006), who were interested to participate in this study. The participants were homogeneous in terms of their ethnic, demographic and socio-economic characteristics (see Appendix 1).

Data were collected from this cohort of participants following in-depth one-to-one interviews in order to improve the rigor of this study (Patton, 1990; Morgan, 1996; Khan *et al*, 2002; Sarantakos, 2005). Tarafder *et al*. (2012) study also applied the one-to-one interview method to gather data from the participants. Each of the in-depth one-to-one interviews was held at a neutral, safe and comfortable place (Burgess, 1996; Powell and Single, 1996) of the participant's choice, such as, their home, yard or paddy field. This alleviated concern and enabled the participants to share their views without hesitation.

The data for this study was collected using semi-structured questions following the suggestions of current studies (Brenner, 1985; Frey and Fontana, 1994). The questions were in an order that maintained a coherent flow in the conversation (Mullins and Kiley, 2002). The following is a set of guiding and sample questions:

1) What kinds of reproductive health beliefs did you have after your marriage?
2) What kinds of reproductive health beliefs did you have when you were a first pregnant?
3) What kinds of reproductive health beliefs did you have after becoming mother of a first child?
4) How did you receive the reproductive health beliefs?
5) Why do you trust the reproductive health beliefs?
6) What kinds of reproductive health perceptions do you currently hold?
7) Whom do you prefer to seek care for your reproductive health?
8) Why do you seek reproductive health care services from this person/centre?

The participants of this study work both at home and elsewhere, and thus we avoided creating any 'time-stressed situation' (Desai and Potter, 2006). Each of the in-depth took less than two hours and about one and a half hours, respectively. Each interview was taped with an agreement of the interviewees, and then transcribed in Bengali. These were then transcribed into written English by the lead author. The authors, having skills in qualitative research and in both languages, independently reviewed the transcriptions and made necessary amendments. This research received ethics approval from the University of Canberra, Australia (Reference No. 12-70).

The content analysis procedure was employed to analyse the qualitative data (Krippendorff, 2012). The first stage included identifying the recorded information that was important for developing themes and interrelationships following theoretical and conceptual suggestions (Neuendorf, 2002; Krippendorff, 2012). These were then coded by assigning key words

suitable for a section of text, giving a particular meaning to or labelling a section of the material (Sarantakos, 2005). The coding process not only involved categorising the chunks of texts but also included memoing the data that is in short notes, backgrounds, ideas or thoughts about coding data (Sarantakos, 2005; Babbie, 2008). Finally, texts were categorised based on their respective coding. This was done in order to find the emerging themes for this study. The authors collaborated closely to identify emerging themes and sub-themes, and to verify their findings.

4. FINDINGS AND DISCUSSION

The present study has applied the tenets of Sen's 'capability approach' to illustrate the main and sub-themes of this study. However, the difference between Tarafder *et al*. (2012) study and this study is based on the aspects of education and knowledge of the 'capability approach.' This study focuses on the participants' capacity in interpreting the medical emergency and understanding importance of reproductive health situation which has been integrated while discussing the themes of the research findings. Tarafder *et al*. (2012) study highlighted on the aspects of participants perceptions regarding the reason for not accessing reproductive health care services. The themes of this study and the study by Tarafder *et al*. (2012) share similar understandings of Tarafder (2013) thesis entitled "Reproductive health care services of rural women in Bangladesh: a case study of beliefs and attitude."

The findings are arranged according to the themes and sub-themes that emerged from the data analyses. This study identified three major 'belief themes', including: (i) a strong belief in TH; (ii) a strong influences of in-laws and seniors/elders; and (iii) traditional beliefs, and their reasons. Four major factors contributing to attitudes were identified and these are also discussed in this section.

(i) A strong belief in Traditional Healers ('Kabiraaj')

The current study found that more than 80 per cent of the participants have a firm belief in TH, and that they rely on TH's treatments for their ailments. THs are believed to drive away malevolent or malicious spirits and deities, determine the cause of a disease, and administer remedies based on his knowledge in holy verses. The participants of this study believed and confirmed that belief in TH is necessary in the healing process; otherwise the medicine won't work for them. The following quotes illustrate their beliefs:

> *For my reproductive health care, I saw the traditional healer to get holly water or sanctified water. When I was pregnant I took holly water from the traditional healer to get cure. We prefer traditional healer more than the doctor because traditional healer gives us holly blow, hollow water, holly oil that work in our favour. We cannot afford to see the doctor.* (R23)

Another aspect of consulting a tradition healer is relevant to limited financial capacity. Unlike the professional doctor, a traditional healer charges a fee that is affordable by a family, which they generally offer him with a sense of gratitude. As R23 participant, in this context, stated that she cannot afford to visit a doctor.

(ii) Influence of in-laws and seniors/elders

In general, the female of rural communities in Bangladesh were found to obey their in-laws and elderly ladies. It is very rare that they would question the cultural practices and family rules. Following in-law's advice is also a sign of respect and obedience of daughter-in-law. Adhering to a mother-in-law's advice secures the position of a daughter-in-law in her family and establishes a good relationship between them. As stated by R30:

> *I obey each word of my guardian. During my pregnancy time, I followed several ruled imposed by the elders such as not to go outside. I did never keep my hair open during the pregnancy*

> *period. I never go outside at evening and night. I listen to everybody. Yah I like to obey them. Whatever they tell me I obey that without thinking. Yes I will listen to my mother in law because they will tell good things for me. All people say good thing. I always obey their words.*

Rural women who live with an extended family rely on the decisions of in-laws and elderly woman in the family (Chowdhury *et al*, 2007) and have less control over their reproductive health related matters (Hossain *et al*, 2011). Thus, mother-in-laws play a vital role in decisions related to giving birth and the delivery process of the pregnant women in Bangladesh (Piet-Pelon *et al*, 1999).

Inequality and power differences are mostly observed in the less developed countries, like, Bangladesh, where members are expected to live in a collective culture, meaning that members behave according to social norms that are designed to maintain social harmony among members in a group (Hofstede and Hofstede, 2001). The findings also reveal that participants were affected in many ways by following social and familial beliefs that are channelled through elders, in-laws and TH. Often this causes life threatening consequences both for rural pregnant mothers and their un-born children with a concomitant neglect for their reproductive rights. Reproductive rights do not depend on the in-laws to decide how many children a couple should have, but it depends on the couples to decide freely on the number and spacing of the children (Hossain *et al*, 2011). As a result, advice from in-laws and seniors often takes the form of fear factors that have negative connotations though in some instances these have some good effects.

(iii) Traditional beliefs

Rural Bangladesh has many traditional beliefs and misconceptions that are related to reproductive health issues, mainly because of lack of education. Poor social and familial infrastructure along with poverty has accelerated rural participants to firmly hold these traditional beliefs. An important example is malicious spirits.

There is a strong belief that a malicious spirit can cause damage to an unborn child and to a pregnant woman. Thus, any miscarriage is blamed on the presence of malicious spirits. A number of studies (e.g. Blanchet, 1984, 1991) have observed that pregnant mothers and the mothers of newly born children are strictly forbidden to go outside in the dark, in the afternoon, in a storm, after cooking, near a tube well, with their hair down or with their saree (traditional dress) touching the ground—all due to fear of attracting evil spirits. In this connection, one of the participants (R3) stated that:

> *For malevolent spirit a pregnant woman cannot go outside. For example malevolent spirit can harm an inborn child and even an in born child can be aborted for it. That is why our neighbours say that do not go outside and stay at home. Especially, it is not proper to go outside during mid-day or evening time. In addition, my neighbours say that do not go beside a pond during mid-day, do not go to a toilet at night, and do not wake at night. This is all about pregnancy.*

Seclusion after giving birth is observed due to the new born's mother's post-partum bleeding (Darmstadt *et al*, 2006). The post-partum stage is linked with heavy menstruation and women feel polluted, impure and stinky (Blanchet, 1984, 1991). It is believed in a rural context of Bangladesh that the malicious spirits are the reasons for excessive, forceful and continuous bleeding and bleeding with clots (Sibley *et al*, 2009), and they should perform very light household works for the first forty days of giving birth and must remain inside the house all the time to avoid evil spirits (Darmstadt *et al*, 2006; Edmonds *et al*, 2011). Although forty days post-natal in-door stay is a kind of incentive for a new mother to get some rest from her domestic workload (Edmonds *et al*, 2011), these mothers often suffer from severe

malnutrition from not eating poultry foods and due to the seclusion during the post-partum period from the rest of the family (Darmstadt *et al*, 2006).

Factors Contributing to Held Health Beliefs

The demographic and socio-economic data, and data collected through interviews reveal four major factors that are contributing to held participants' attitudes toward reproductive health beliefs, and hence they are more inclined to get reproductive health care services from local TH. The four key contributing factors are: Poverty, Education, Access and Availability, and Knowledge.

(a) Poverty

Poverty is the single most powerful truth in rural Bangladesh; and one of the major reasons for accessing TH. Sen (2001) stated that poverty is interlinked with the stages of functioning or doing and well-being of a human being, and thus it puts a limit on accessing commodities, activity levels in daily social life, access to medical services and the ability to use them and having nutritional knowledge and education.

The participants of this study were so concerned with basic needs, such as food, that and they relegated their health concerns to a secondary position. In a poverty prone area, people with a low income either seek free treatment, treatment at the lowest possible cost, or health care services that are nominally priced (Schuler *et al*, 2002). Poverty also limits the capacity of a person in terms of being resourceful, intelligent and functional in day to day activities (Yunus, 2003).

(b) Education

Lack of individual initiative and unawareness of what might constitute a medical emergency is related to rural women being not exposed to proper and modern education facilities. Comprehending the medical emergency and responding to it is an important action of an individual initiative. R3, for example, has never taken any decision regarding health. She had a limited knowledge about a medical emergency and the importance of seeing a doctor.

> *I have to belief myself. Moreover, whatever doctor say to do this or to do that will not happen and we will not belief it. I have to belief myself. I cannot depend on the doctor. I cannot dance on the words of the doctor. This cannot happen. I have to have a belief.* (R3)

Inability to respond to medical needs and a delay in seeking medical care for reproductive matters are connected to the participants' incapability to interpret their health conditions. This study found that the women living in slum areas do not have proper education at least to interpret their health related needs including reproductive care. In particular, one respondent stated that

> You see when I am pregnant I had to follow many beliefs. I listened to my mother in law. I listen to my mother in law so that there is no harm to my in born child and myself. If anything happens my mother in law may blame me because I did not follow her instruction that's why now doctor is needed. That why I follow these beliefs. (R 20)

Research finds that early marriage leads to unwanted pregnancy (Khan *et al*, 2002) and delayed marriage resulted in South Asian women to become more independent and self-confident than the women who got married at an earlier stage in their life (Jejeebhoy and Sathar, 2001). In our study, a number of participants were below 20 years old, and had only a vague idea about the basics of reproductive health. Khan *et al*. (2002) study found that the rural girls who were married before the age of 16 years rarely had any idea of how children are conceived and the mechanism of contraception. The discussion of contraceptive usage was introduced to them on the day of their marriage or two days before their marriage. In their

study, Hossain *et al*. (2011) stated that Bangladesh has one of the highest rates of child marriages in the world and nearly two in five girls aged 15-17 are married before 18, despite 18 being the legal age of getting married. A high fertility in younger age and a low birth weight of her child cause poor physical and mental development both for mother and her child, respectively. In consequence, this limits the progress of human development as they both lack physical and cognitive abilities.

(c) Access and Availability

One of the aspects that affect the belief structure of the slum women is the barrier for accessing reproductive health care services. During the field study in Meherchondi village, it was found that many participants had to deliver their own children due to not having traditional birth attendants or TH during the delivery time.

(d) Knowledge

Knowledge about one's health, availability and accessibility to medical facilities put any disadvantaged person into an advantaged position. This ensures the capability of a person. Sen (2001) stated that one would be incapable of functioning a normal life if (s)he does not have an access to a better medical facility.

A formal education is not only the source of knowledge, there are several sources one can acquire knowledge from, including for example, informal discussion, and electronic media discussion and demonstration. Knowledge about one's potential and abilities, perhaps, is the single most powerful driving force to be productive and conscious.

In a rural society, where in-laws, husband and seniors/elders dominate, dissemination of health knowledge is indispensable to all levels in this hierarchy. Like other participants, R20 also understood that there has to be a balance between meeting the expectations of the in-laws, seniors/elders, tradition, and gaining knowledge and getting proper reproductive health services.

5. CONCLUSION, IMPLICATIONS, LIMITATIONS AND FUTURE RESEARCH

The participants of this study stated that this had been the first time for them to speak to someone outside of their community about their pregnancy related beliefs. They felt that someone had been listening to them and they also have had a voice and story to tell. They felt they were important as human being and 'included' in a greater society. The findings of this study suggest that the key to improving slum women's health lies in freeing them from mythical beliefs and misconceptions; generally borne in rural areas, where poverty, education, access to medical facilities, and knowledge are great concerns.

Amartya Sen's 'capability approach' is grounded on human freedom, both intrinsically and extrinsically. This freedom, for example, is an access to basic human needs such as health. One would be incapable of functioning a normal life if (s)he is deprived of or not having an access to better medical facilities. Having the knowledge of medical facilities, for instance, and be able to use them, puts any disadvantaged person into an advantaged position, which ensures the capability (functioning) of a person; and this in turn ensures happiness (well-being). An access to better resource and leading a comfortable life style do not define the capability of a person. It is freedom in terms of both physical and mental state that represents the capability of a person. Poverty is interlinked with the stages of functioning or doing, and well-being of a human being. Poverty puts a limit on accessing commodities, activity levels in daily social life, access to medical services, one's ability to participate in economic activity and have education and nutritional knowledge. Thus, there is an inverse relationship between poverty and capability (summarised from Sen and Hawthorn, 1988; Sen, 1990, 1992, 2001).

The findings of this study are an indication, only. For example, this study provides an insight and indication of the current state of achieving one of the millennium development goals (MDGs) of Bangladesh, 'improve maternal health' (Goal 5) by 2015. This study could be a useful framework and a point of departure for developing programmes for this vulnerable cohort living in the slum area in Meherchonchi, Rajshahi, Bangladesh. This study could also assist strengthening the current and relevant policies and strategies.

This study has practical implications for NGOs, as well. This study can potentially broaden the understanding of reproductive health care services to people in rural Bangladesh and improve the outreach of services in rural communities. As a result, NGOs can reform their practices and advocate for changes to government policies on reproductive health care issues in Bangladesh. The findings also reveal that the current education of the participants does not contribute to motivate them to access to health care clinics. One of the reasons is the education system itself where they are either not bound to go to schools or the curriculum is missing a significant issue in year 5-12 that is reproductive health and its relationship with health care clinics and TH.

There are several limitations in this study. This study took a sample size of eight participants, and they were in-depth interview was conducted. Some of the participants were found reluctant in focus group discussions; may be due to peer influence and/or having not adequate knowledge. With such a small number of participants and one village, this study does not afford to generalise its findings. However, this study generates valuable insights that can be used to develop greater statistical follow-up studies from the rural areas of Bangladesh. Finally, participants' personal details, such as, address, name, age at marriage and age at first child remained anonymous due to the approved conditions of the human research ethics approval.

Future study should have broader samples that can afford to generalise its findings. While collecting data in the field for this work, many participants stated that their fertility rate is low and they do not know why. Future study should explore this further. Future study should also examine how religious affiliation could affect one's beliefs and perceptions about reproductive health.

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Ecological Footprint and Regional Sustainability: A Review of Methodologies and Results

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ABSTRACT

The method of ecological footprint describes an area-based resource accounting tool and has been used in different regions and countries to assess sustainability. This paper reviews published studies that measure regional sustainability based on the Ecological Footprint and Stochastic Impacts by Regression on Population, Affluence and Technology methods. Literature searches in different on-line data bases using various criteria were used. Articles were categorized by the nature of each study, the degree of analysis, and the geographical location of each study. Forty-nine studies satisfied the inclusion criteria. The majority of the studies considered only environmental indicators. Two other indicators (social and economic) were rarely covered. Other issues that explain the variation in the results included methodological choices, unproductive land areas, production and imported commodities. This paper highlights the three main indicators used to measure regional sustainability as well the key issues not fully addressed in the literature.

1. INTRODUCTION

Sustainability is concerned with the integration of ecological, social and economic issues to maintain the quality of life (Sutton, 2000). It requires that future generations are able to enjoy at least the same levels of wellbeing as the current generation (National Sustainability Council, 2013). The word "sustainability" originated from the 1992 Earth Summit held at Rio de Janeiro, Brazil. Sustainability is an outcome of interactions between economic activities, social progress and environmental limits (Yencken and Wilkinson, 2000). There are various models and methods used to explain the term "sustainability," namely, the Russian doll model, three pillars model (Yencken and Wilkinson, 2000), the five capital framework (Parkin, 2000) and the ecological footprint (EF) method (Wackernagel and Rees, 1996).

All of these approaches emphasize the achievement of sustainability through a compromise between social, economic and environmental factors. However, it is not possible to separately achieve a given level of ecological, social or economic sustainability without achieving at least a basic level of all three forms of sustainability, simultaneously (Sutton, 2000). Sustainability acts as a unique sub-system within the overall system. Sub-systems may not be sustained if the overall system becomes unsustainable. This notion implies that local or regional sustainability can be achieved only if the global society at large becomes sustainable. Therefore, there is a great tendency to fail to achieve local sustainability through ignoring combined catalytic functions in order to achieve global sustainability.

Assessing the level of regional sustainability is more crucial than achieving it. It is also necessary to identify the various driving forces of regional sustainability. There are many single and aggregate indicators and methodologies to measure the status of regional sustainability. Most of the studies conducted to assess sustainability have utilized environmental indicators, followed by economic and social indicators. These studies first used the EF method to analyse regional sustainability through regional resource consumption, and later, the Stochastic Impacts by Regression on Population, Affluence and Technology (STIRPAT) method was increasingly used to analyse the anthropogenic forces of EF, aiming to serve local sustainable development decision-making (Mingquan *et al*, 2001).

To assess the status of sustainability, ecological supply or ecological capacity (EC) (i.e. the regeneration of natural capital) needs to be subtracted from ecological demand or EF (consumption of natural resources). If this yields a positive number, i.e., EF exceeds EC, an ecological deficit occurs, which indicates an unsustainable regional system (Kitzes *et al*, 2007). Therefore, a positive footprint (i.e., ecological deficit) implies that a region's natural capital is being depleted, or that it is imposing part of its footprint on another region via importation. A negative figure indicates an ecological surplus such that the population has an ecological remainder, or a remaining ecological capacity for that population. By providing a means of comparing human demand and nature's supply in the same unit of measurements, the assessment results clearly show, the magnitude of the human load on the biosphere at each graphical scale of analysis (Wackernagel and Yount, 1998).

During the 20th century, the majority of world's nations has undergone rapid economic development on the one hand and engaged in unprecedented consumption and losses of natural resources on the other. Therefore, the global ecological situation has progressively deteriorated following the imbalance between ecological demand and supply. The remainder of this paper is divided into eight sections. Section 2 provides a brief description of the different interpretations of sustainability within the literature. Section 3 examines the various single and integrated indicators of the measurement of sustainability. Section 4 shows the ecological footprint calculation methodology used to assess regional sustainability. Section 5 reveals the major driving forces of regional environmental sustainability. Section 6 entails the regional sustainability assessment results as proposed in the literature. Section 7 discusses various key issues in the literature regarding the ecological footprint and STIRPAT analyses. The paper concludes with a summary of findings.

2. SUSTAINABILITY: DIFFERENT INTERPRETATIONS

The word "sustainability" has increased the global focus on the environmental, social and economic status of a given country or region, especially since the Earth Summit. Numerous discussions of sustainability emerged within the global arena at the 1972 UN Conference on the Human Environment in Stockholm. At this conference, 113 nations pledged to begin cleaning up the environment and, most importantly, begin the process of tackling environmental issues on a global scale (Kenworthy and Newman, 1999).

The definition of sustainability is still debatable. Yencken and Wilkinson (2000) defined the term sustainability through the "three pillars model," while Parkin (2000) argued the "five capitals framework". The former model is based on the factors of social, environmental and economic sustainability which all inter-relates to create sustainability, the latter model is more complex, involving the triple bottom line (TBL) and the quadruple bottom line to help form the basis of the five types of capital: natural, human, social, manufactured and financial capital. Sustainable development can also be expressed through a simple Venn-diagram in the Russian doll model. This model explains the basic principle of sustainability through

interactions among economic activities, social progress and environmental limits.

To ensure sustainability, resources must be used in the short -term in such a way that these resources will also be available in the long-term. Therefore, the use of current natural resources, such as water, trees, soil and air, must be maintained in ways that do no compromise the future use of these resources. Moreover, to ensure regional sustainability, it is necessary to achieve economic objectives while also minimizing damage to social and environmental objectives. To promote sustainability, it is important to consider the implications of an economy that does not take into account its effect on the surrounding environment. Eventually, sustainability manifested in different forms such as social, economic, environmental and cultural sustainability.

The Brundtland Commission (WCED, 1987) defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." This is the starting point from which to build the concept of sustainability. Sustainability implies that nature's capital should be used no more rapidly than it can be replenished (Wackernagel and Rees, 1996). The common use of the term "sustainability" reflects a remarkable commitment to this value in our society. Now, society feels an obligation to protect natural resources, the ecosystem, biodiversity and the productivity of the environment for the benefit of current and future generations because a healthy environment is a necessary element of a productive economy, and therefore human wellbeing. Sustainable development does not encompass only the socio economic perspective, it also incorporate the ecological system, so it is necessary to integrate social, economic and ecological system into a complex-holistic system to ensure the sustainable development. (Imran *et al*, 2011).

Wackernagel and Yount (1998) defined regional sustainability as "the continuous support of human quality of life within a region's ecological carrying capacity." Regional populations also play a critical role in ensuring sustainability. In this way, it has been well articulated that regional population structure impacts equity, at the interface between economy and society, quality of life, at the interface between society and ecology, and sustainability, at the interface between economy and ecology (Stilwell, 1997). Stilwell confirmed that if growth in material consumption and population is matched by the efficiency of material and energy use, the achievement of a sustainable regional society is feasible. The meaning of sustainability in this paper encompasses regional environmental aspects and environmentally sounds regional development over time.

3. SUSTAINABILITY: METHODOLOGIES AND INDICATORS

Over the past decade, a number of methodologies and indicators have been used to assess sustainability. Sustainability can be assessed either through a single indicator or a set of multiple set of indicators, i.e., aggregate indicators. These indicators assess the sustainability of either the whole system or parts of the system, such as the economy, society or the environment (Graymore *et al*, 2008). From an examination of the literature, the classification of methodologies and indicators is summarized in Table 1 of the Appendix, adapted from Hanley et al. (1999) and Sustainability Australia Report (2013). The wide range of indicators is classified into three groups, namely, economic, ecological and socio-political indicators. These three classifications possess some degree of overlap, reflecting the complex and interdisciplinary nature of sustainable development.

Each of these three major classifications can be further sub-divided into single or aggregate indicators. Single indicator can be found in a variety of sources and are used in numerous studies on different spatial and temporal scales. Green Net National Product (NNP)

(Hartwick, 1990) and genuine savings (Pearce and Atkinson, 1993) have been used as aggregate indicator to measure economic sustainability, whereas among single economic indicators, Gross Domestic Product (Hanley *et al*, 1999) and consumption per capita (Singh *et al*, 2009) have been frequently used. On the other hand, the EF and net primary productivity have been extensively used to measure environmental sustainability. Greenhouse Gas (GHG), Carbon dioxide (CO_2) and Sulphur dioxide (SO_2) have been used as single indicator of air quality to assess environmental sustainability.

Most authors would describe green NNP and genuine savings as weak measures of sustainability, while EF might be considered a strong measure (Hanley *et al*, 1999). Genuine progress indicator and the human development indices assess socio-political sustainability as aggregate indicators. Siche *et al*. (2009) mentioned that energy analysis and material flow accounting have also been used, including EF in the last few years on a regional scale. The literature confirms that a few other methodologies used to measure sustainability namely, life cycle assessment, input-output analysis, and wellbeing index.

The EF methodology, to assess the level of environmental sustainability and the STIRPAT, to identify the factors on environmental sustainability, are the core of recent ecological research literatures. As the core of the former model, EF has been used as an effective assessment tool to measure environmental situation and the level of resource consumption (Wackernagel and Yount, 1998). Since the middle 1990s, the STIRPAT model has been employed to assess the factors responsible for environmental impacts (Dietz and Rosa, 1994). Thus, the combination of the EF and STIRPAT methods has been used for the quantitative analysis of sustainability in regions, cities or countries.

4. ECOLOGICAL FOOTPRINT: MEASURING REGIONAL SUSTAINABILITY

The concept of the EF represents tool for the comprehensive assessment of the status of sustainable development, based on an integration of resource consumption and land capacity that reflects human impact on the environment. The EF measures the biological productive land and sea area needed to meet the consumption and absorb all their waste of a given population (Global Footprint Network, 2011). The tool then compares how much land and sea area is available for that given population. Within this context, the former is known as ecological demand and the latter as ecological supply. By using ecological demand and supply, this method reveals the level of environmental sustainability of the region (Wackernagel and Yount, 1998). Accordingly, the calculation of EF and EC can be expressed as:

(1) $$EF = N(EF_i) = N\sum_{i=1}^{n} r_i (C_i / Y_i) = N\sum_{i=1}^{n} r_i \frac{P_i + N_i - X_i}{Y_i}$$

(2) $$EC = N \times (1-12\%) \sum_{j=1}^{n} a_j r_j y_j$$

In equation (1), N refers to the total population of the study area, i refers to different consumption items, C_i is the per capital consumption of i item, Y_i is the average productivity of item i for a corresponding bio-productive area, r_i is the equivalence factor,[1] $P_i + N_i - X_I$ denotes net consumption, where, P_i is the production of item i, N_i is the import of item i and X_i is the export of item i. In equation (2), a_j is the per capita biological productive area of j type land, y_j is the yield factor of j type land and r_j is the equivalence factor of j type

[1] The equivalence factor represents the conversion rate from hectare to global hectare which is constant for all countries for a given year.

land.[2] Consumption and land area are divided into 5 and 8 categories, respectively. The EF is then calculated by compiling a matrix in which an area of land is allocated to each consumption category. To calculate the EF per-capita, all land areas are added up, and then divided by the population, yielding a result in hectares per capita.

5. FACTORS RESPONSIBLE FOR REGIONAL SUSTAINABILITY

Every person presents a demand for resources for the fulfilment of his or her basic needs, such as food, water, clothing, and shelter, among others. With a larger population, more resources are demanded. Therefore, it is generally assumed that every person and each populated area (e.g., a region, city or country), has an impact on the environment. The I=PAT formula has been employed since 1970 to assess human impacts on the environment and measures the forces of environmental sustainability, introduced by Ehrlich and Holdren (1971). The principal idea of an I=PAT entity is that environmental impact (I) is the product of three key driving forces: population size (P), affluence (A) described as consumption or production per capita, and the level of environmental damage caused by technology (T) described as consumption or production per unit.

Until 2005, a series of reformations of the IPAT formula had been conducted in the ecological literatures. Waggoner and Ausubel (2002) added a variable into the IPAT identity, C, which represents consumption per unit of GDP, thus resulting in I=PACT or ImPACT. Subsequently, Schulze (2002) introduced the refining equation of I=PBAT, indicating that affluence and technology do not dictate behavioural decisions, therefore, he added another variable, B into the I=PACT formula and argued that human behaviour is a key driving force of environmental impact. Xu, Cheng and Qiu (2005) mentioned two additional variables, social development (S) and management (m), explaining social development and society's capability to decrease environmental impact. Eventually, this explanation was contrasted by the notion that society and social development have proven difficult to quantify.

The IPAT identity, relabelled the 'Kaya' equation, lies at the heart of the efforts to project greenhouse gas emissions by the Intergovernmental Panel on Climate Change. Consequently, all the above models do not permit tests of the hypothesis about human driving forces and environmental changes. To eliminate any potential problems, York *et al*. (2003) reshuffled the IPAT identity into the STIRPAT model, which harmonizes non-proportionate impacts of population on the environment in the following form:

$$I_i = aP_i^b A_i^c T_i^d e_i$$

or in the log form:

$$\text{Log I} = \text{a} + \text{b(logP)} + \text{c(logA)} + \text{d(logT)} + e$$

The subscript 'i' denotes the number of observations, namely, regions in this study. The constant 'a' scales the model, and the residual or error term, 'e', possesses the effects of all other variables of I that are uncorrelated with P, A and T, while b, c, and d, are the exponents or coefficients of these independent variables that must be estimated from the regression. The explanatory variables P, A and T denote population size, GDP per capita and impact per unit of consumption, respectively. In addition to the basic forces (P, A and T) of the STIRPAT model, many researchers have added several others forces that are conceptually compatible with the model. An overview of various driving forces or variables used in the study of the STIRPAT model is highlighted in Table 2 in the Appendix.

[2] The yield factor refers to the productivity coefficient for different land types in proportion to the world average. This is specific for each country and each year.

6. REGIONAL SUSTAINABILITY ASSESSMENT RESULTS

Assessing levels of regional sustainability and identifying the specific forces driving environmental sustainability comprise a hot topic in the field of ecological economics. Scotti *et al*. (2009) used EF as a tool to measure the local sustainability of the Italian municipality of Piacenza as a case study. The authors showed that people living in Piacenza uses an area that is more than nine times the biological capacity of its territory. This implies that Piacenza is not an environmentally sustainable city. Using Input-Output analysis, Environment Protection Authority (EPA) Victoria (2008) revealed that Victoria's footprint is more than three times higher than the world average of 2.2 productive hectares per person. Using the same Input-output methodology, Vic Urban (2007) showed that the overall footprint of an average Aurora resident is approximately nine percent less compared to a conventional five star development. Zhao (2010) analysed the impacts of human activity on the environment in the low temperature pasturing region of Gannan in China. He showed that the EF per capita increased from 0.854 to 1.961 ha/per capita between 1980 and 2007 in the Gannan pasturing area due to an increased population, whose use of intensity was the major driver of ecological footprint, with coefficients greater than 1.0. Chen *et al*. (2001) and Zhao *et al*. (2005) both group of researchers found the ecological deficit of China for the duration of 1981 to 2000 and 2000 to 2005 respectively.

Presenting data on the time path of the seven indicators of sustainability in Scotland over the period 1980-1993, Hanley et al. (1999) found that Scotland is not sustainable according to any measure even though the EF method indicated that the country was marginally sustainable when using actual consumption in the calculation of EF. Taking the Henan Province of China as an example, Jia *et al*. (2009) computed and analysed the province's ecological footprint from 1983 to 2006. The results showed that the EF in the Henan Province quadrupled over the course of those 23 years, its ecological carrying capacity was rather low and in a state of slow decline and the ecological deficit within the province had become a significant social problem. Therefore, the major drivers of Henan's EF were human population size and GDP per capita. Analysing a sub-national area, Siena province in Italy, Bagliani *et al.* (2008) showed that the per capita values of ecological footprint contrasts with the national average and most of the other provinces. Urbanization has also an impact on ecological footprint. Using life cycle approach, Wood and Garnett (2010) showed that the environmental impact of urban populations is generally higher than that of remote populations in Northern Australia

Adding the partial least square method to this study, the author showed that the curvilinear relationship between economic development and ecological impact or the classical EKC hypothesis did not exist in the Henan province. The EKC hypothesis states that for many air pollutants, growing levels of GDP per capita initially lead to high levels of pollution which then fall as development increases. Lin *et al*. (2009) shows that population size has the largest potential effect on environmental impact, followed by urbanization level, industrialization level, GDP per capita (Wang and Bian, 2008) and energy intensity. The changes in the EF depend both on changes in per-capita consumption levels and the rate of growth of the population (Hanley *et al*, 1999). Du *et al*. (2006) used the EF methodology through the consumption-land use matrix in a case study of Guangzhou in China for the period 1991-2001 and showed that the cities were ecologically unsustainable, with average ecological conflicts per capita of more than 2 ha. Trade is also an important factor for increasing biophysical carrying capacity which ultimately affect regional sustainability (Daily and Ehrlich, 1992). Refinements to the methodology made since 1997 (Lenzen and Murray, 2001) have allowed and update of the earlier footprint estimates for NSW and comparisons with recent data. These show that the NSW community increased its total footprint by 23 per cent in the five

years between 1993-94 and 1998-99. During this period, the population grew by 7 per cent implying that the EF is associated with population changes.

Madu (2009) showed that population size and affluence were the most important anthropogenic drivers of environmental impacts in Nigeria, while urbanization or modernization brought about a reduction in environmental impacts. Zarzoso *et al*. (2007) conducted a STIRPAT analysis on the determinants of carbon dioxide emissions in the European Union for the period 1975-1999. The results showed different patterns for old and new EU members. For the first set of countries, the elasticity emission-population indicator measured lower than the unity indicator does, whereas in the second group, the elasticity measured 2.73, which is in accordance with the higher environmental impacts observed in less developed regions. Nevertheless, it remained unclear whether a demographic decline will curb CO2 emission.

Roberts (2012) used the STIRPAT framework to assess the strength of age-structure in driving US county-level CO_2 emissions. This estimates provide a complex picture of age structure with respect to carbon emissions; counties with older working-age populations have higher emissions than their younger counterparts, while the size of the total dependent population illustrates no significant relationship. Knight and Rosa (2012) established a link between household dynamics and environmental impacts using a STIRPAT analysis. The results show that nations with smaller average households consume more fuel wood per capita.

Wang *et al*. (2011) employed the STIRPAT model to reveal the factors that contribute to CO_2 emissions in the Minhang District, Shanghai, China. They found that population size, affluence and urbanization level increase CO_2 emissions while energy intensity decreases CO_2 emissions. The same result revealed by Romero Lankao *et al*. (2009) and Huang *et al*. (2007), population size is the significant driver of environmental impact. Shi (2003) found that global population change over the last two decades is more than proportionally associated with growth in CO_2 emissions, and that the impact of population change on emissions is much more pronounced in developing countries than it is in developed countries. Fan *et al*. (2006) revealed that it was the impact of population size, affluence and technology on the environmental varied at different levels of development. In comparison to the impact of urbanisation and geographical factors on environment, York *et al*. (2003a) mentioned that the National affluence and GDP per capita has a strong effect on environment.

Using the EF method, Ying *et al*. (2009) found that the Yunnan province of China surpassed the state level of China, indicating that Yunnan was unsustainable on the national scale. Cole and Neumayer (2004) showed that population increases were matched by proportional increases in emissions, while a higher urbanization rate and lower average household size increased emissions. Madu (2009) measured environmental impact as a dependent variable by the rate of vegetation loss. She showed that this measurement assessed the cumulative effects of vegetation loss on soil, the water cycle and wildlife. Secondly, there is no data on carbon dioxide emission within both the state and geo-political zones in Nigeria. Ping and Xinjun (2011) applied the EF and STIRPAT methods within the Yangtze Delta Region (YDR) and its 16 cities to assess their sustainability status and analysed the relevant driving factors. The research showed that the distribution pattern of the EF and the degree of sustainability development varied distinctly from city to city in the YDR. The driving factors that made the greatest change in EF was GDP per capita, and the classical Environmental Kuznets Curve (EKC) hypothesis did not stand in YDR's EF.

Using the human development index (HDI) and ecological footprint as measures of urban welfare and ecological burden, Lin et al. (2010) carried out a case study of Xiamen city from 2000 to 2006 and showed that the increase of ecological consumption is faster than the improvement of social welfare. As a result, urban sustainability declines. In measuring regional sustainability, the literature review show that the maximum number of studies uses environmental sustainability indicators instead of economic and social indicators. The list of the reviewed literature is shown in Tables 3 and 4 of the Appendix.

7. KEY ISSUES IN MEASURING REGIONAL SUSTAINABILITY

Regional application of EF, IPAT and STIRPAT

The applicability of EF to measure the sustainability of a region and assess the ability of IPAT/STIRPAT to identify the forces of sustainability of a region; a debatable issue in the contemporary ecological economics literature. Therefore, there are several arguments for and against the appropriate scale of the application of IPAT and STIRPAT, and, whether these models are fit for the local or regional aspects of assessing environmental impact. DeHart and Soulé (2000) mentioned that IPAT appears logical when applied to global environmental change. However, the authors used the IPAT formulation as a framework to test the relationships between driving social forces and user-group greenhouse gas emissions in north-western North Carolina. They found that various measures of population size and affluence serve equally well as explanatory variables of greenhouse gas mission in the study area. Turner *et al*. (1995) responded that when assessing regional environmental impact, the IPAT identity ignores the impact of external forces. Alternatively, Mace *et al*. (2013) mentioned that while most STIRPAT analyses have been applied at the macro-level in countries, the model is applicable to any spatial scale from nations to cities.

Additionally, in the case of EF, there is considerable literature that reveals both the positive and negative implications of measuring regional sustainability. In EF calculation, different consumption categories need to be converted into land area to measure the related ecological impacts of a region but this conversion is necessarily incomplete, while regional and local features of land types and land use are not take into account (Bergh and Verbruggen, 1999). Archibugi *et al*. (1989, pp. 1-2) indicate that the EF is treated as single indicator. Sustainable development cannot be measured by this single indicator, but rather requires a broad spectrum of manifest indicators. The authors mentioned that for example, landscapes sometimes changes not only due to various changes in land use patterns but may also be due to factors outside the agricultural system itself e.g., climatic changes.

Wackernagel and Rees (1996) calculate EF on global, regional, national and local scales, both on a total and per capita basis. Alternatively, Bergh and Verbruggen (1999) explained that the EF estimates are rather arbitrary from an environmental point of view. These authors said that national boundaries are of a geo-political and cultural nature and have no environmental meaning. If one wished to focus on regional footprints, then it would make more sense to define the regions from an environmental perspective. Wackernagel *et al*. (2004) also argued that it is useful to analyse EFs at the national level and compare the results with national capacity because nations are the largest decision-making body. However, many researchers assesses the sustainability of a region, such as a city, municipality, province and country with only the EF method or EF with others method.

Inclusion/exclusion of variable T (technology) into error term at STIRPAT

Whether T need to be included in or excluded from the error term in the STIRPAT model is an important issue in assessing the driving forces of sustainability. Madu (2009) included T in

the error term in his study because appropriate direct measures of technology are lacking. In a typical application of the basic STIRPAT model, T is included in the error term, rather estimated separately. The modifications yield the model: Log I = a + b(logP) + c(logA) + e. Many studies simply drop T altogether, preferring to estimate P, A and A^2 without the difficulty of pinning T down to a single metric (York *et al*, 2003) as: Log I = a + b(logP) + c(logA) + d$(LogA)^2$ + e. Regardless of the specific approach, T remains difficult to translate into a single variable.

Disaggregating T (technology)

Sometimes, researchers disaggregate technology (T) by adding other variables into the equation. In the logarithm format, it becomes naturally additive (Cole and Neumayer, 2004). Using the natural logarithm, the coefficients of the independent variables can be estimated as elasticity, where changes in any explanatory variables cause per cent changes in the dependent variable. York *et al*. (2003b) suggested that other explanatory variables can be added to the basic STIRPAT model, subject to the addition of variables that are conceptually consistent with the specification of the model. Thus, most STIRPAT research uses the econometric framework as a starting point, and then specifies models on different scales by simply adding or dropping variables. In most of the cases, population size (P) and affluence (A) described as GDP per capita are used as explanatory variables, while the ecological footprint, energy footprint, CO2 emission and GHG emission are the most common derivatives of environmental impact (I) treated as dependent variables.

Shi (2003) disaggregated T into two parts. The first is indicated by manufacturing output as a percentage of GDP (denoted by M) and services output as a percentage of GDP (denoted by S). The author used the per cent of manufacturing and services to capture the difference in T. She expected that the economies whose GDP outputs are heavily derived from manufacturing will be energy-intensive and will produce higher environmental impacts; whereas economies whose GDPs are largely derived from services will be less energy-intensive and will produce lower environmental impacts.

Technology, T, is a broad term that is intended to reflect technological, cultural and institutional determinants of I, i.e., anything that could affect I/C (impact per unit of consumption or production). Cole and Neumayer (2004) in their study on examining the impact of demographic factors on air pollution, used two measures of T, a country's energy intensity (total energy use per unit of GDP) and the share of manufacturing output in GDP. Energy intensity provides a measure of "energy productivity" and as such should be directly related to the levels and types of technology currently in place within a country. Similarly, the share of manufacturing provides a measure of the industrial structure of an economy, which is a clear determinant of the impact per unit of production.

Degrees of land use

The condition of land depends on the degrees and nature of the activities that take place on it. Some lands are used extensively, while some lands use less, but in the original the EF calculations, there is no demarcation among these types of lands for conversion. For example, some farmers in Australia cleared their lands more extensively than others for natural vegetation purposes (Lenzen and Murray, 2003). Extensively used land is more vulnerable to environmental impact than less extensively used land. In addition, extensively used land is more likely to create soil salinity and erosion. Furthermore, EF calculations do not distinguish between sustainable and unsustainable land, instead, these calculations measure the overall hypothetical land (Bergh and Verbruggen, 1999). These calculations does not take symptoms of unsustainability such as soil degradation and unsustainable land use into account, to

measure the level of sustainability of a region, which is a critical issue in the literature. Using land for infrastructure clearly more environmentally destructive than designating it for pasture but the implications of this distinction are not seen within the original ecological method. Rather, a fixed weighting standard using equivalence and local yield factors use different land use matrices to measure varied environmental impacts.

Exclusion of unproductive land use in EF calculation

In the original EF calculation (Wackernagel and Rees, 1996), land that is unproductive for human purpose, such as deserts and icecap's was not included in the measurement of regional sustainability. This type of demarcation between productive and unproductive land use in EF calculations has been criticized by researchers (Lenzen and Murray, 2003). A problem with this approach is that deciding which land is 'unproductive for human purposes' is subjective (Lenzen and Murray, 2003). For example, the Walpiri people of Central Australia have lived in deserts for thousands of years. In addition, land disturbance in Australia caused by cattle grazing and mining is common. In both these cases, the results indicate a degree of impacts on EF calculations. Furthermore, humans may benefit from areas that are not directly used but provide rich biodiversity benefits.

Energy use scenario

The EF method is dominated by energy use because of its hypothetical conversion of energy strategy to land use. For example, the land appropriated by fossil energy use makes up more than 50 per cent of the EF estimate for most developed countries (Bergh and Verbruggen, 1999). This method assumes that only forestation reduces the level of CO_2 in the atmosphere, SO_2, NO_2 and other GHG emissions are not taken into account. Therefore, this method only considers the land needed to assimilate the CO_2 emissions from burning fossil fuels. In this context, sustainability is realized if the carbon sink is not exceeded. However, there are lot of other sources namely land clearing, industrial processes, waste and coal seams which are particularly important in many areas of the world, including Australia (Lenzen and Murray, 2001). The method of the conversion of energy uses in the ecological method is also a controversial issue. Two methods, carbon sequestration factor and fuel wood equivalence factor are used to determine the hypothetical energy land but there are many factors, i.e., ways and means, that are needed to calculate the factors associated with this type of land (Hanley *et al*, 1999).

Imported goods and services

The EF of imported commodities has not yet accurately been incorporated into the calculation of an EF accurately (Lenzen and Murray, 2003). Some authors have suggested that Wackernagel and Ree's calculation of EF is an anti-trade mechanism and therefore an objective indicator to assess regional sustainability. Bergh and Verbruggen (1999) mentioned that the relationship between trade and regional sustainability was unclear in the ecological method. Focusing on relationship between population carrying capacity and trade using ecological footprint analysis framework, Lei et al. (2009) expressed that the trade can have positive or negative impacts on demand and supply of resources and often changes the ecological carrying capacity of a country, region or city. But in the EF calculation, trade is allowed only up to the point where the sum of hypothetical land use domestically and abroad equals the available productive land in the region. However, the calculation completely neglects the comparative advantages of various regions. Moreover, it does not distinguish between imports based on sustainable and unsustainable land use.

8. CONCLUSIONS

This paper gives an overview of the empirical literature on methodologies, indicators and driving forces in order to assess regional sustainability and highlights the key issues not fully addressed in the literature. Overall, most of the empirical studies demonstrate measuring of regional sustainability; first through environmental indicators followed by economic and social indicators. Most researchers use the EF method as an environmental sustainability indicator. However, significant uses of the EF does not mean that this measure has no limitations. Graymore *et al.* (2008) revealed that data limitations on regional level prevented this model from being used to assess regional sustainability. Kitzes *et al*. (2009) urged to improve the calculation of ecological methodology so future research is inevitable.

The EF method also fails to provide detailed policy advice as a predictive measure (Hanley *et al*, 1999). Liyan *et al*. (2007) also mentioned that the EF model emphasized the view of ecology to measure human pressure on natural resources, but it ignores some of the pivotal factors that affect sustainable development deeply, such as the level of economic development, the degree of social welfare, the efficiency of economic resources, and the advancement of technology. Therefore, the Global Footprint Network recommends using it as a complement rather than a substitute when assessing regional sustainability. On the other hand, there are many methods for analysing the human impact on the environment, namely IPAT, ImPACT, IPBAT, and STIRPAT.

This paper finds strong evidence in the literature that use the STIRPAT method most prominently to reveal the driving forces of environmental sustainability. This evidence further indicates that population size and GDP per capita are the dominant driving forces of sustainability. The remaining factors that were found in this review to be significant, they are the measures of affluence, and the industrial share of the economy. In most of the cases it was applied to the macro level of countries but some argued that it is applicable to any spatial scale from national to regional level. This review reveals that there is much inconsistency in the way regional sustainability is measured using EF and STIRPAT model. There is a lack of standard definition of regional sustainability that can be measured straightforwardly and considers social, economic and environmental indicators simultaneously.

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APPENDIX

Table 1: A Classification of Approaches and Indicators of Sustainable Development

Group	Type	Indicators and approaches	Measuring units	Studies
Ecological	Single	Air quality: emissions-CO_2, GHG SO_2, CO	NO_x ppm, SO_x ppm,	UNEP, Various
		Water quality	$DO_{c\ mg/I}$	
		Soil erosion	Tonnes/ha/year	
		Energy intensity	Energy use per capita GDP	
	Aggregate	Net Primary Productivity	Energy/m2 or tonnes/ha	Vitousek *et al*. (1986)
		Environmental Space	Varied	Friends of the Earth (1995)
		Ecological Footprint	ha/person	Rees and Wackernagel (1994, 1996, 2007)
Economic	Single	Consumption per capita	$/person	Hanley *et al*. (1999), Singh *et al*. (2009)
		Real wages	$/person	
		Unemployment	No. of unemployed/region	
		GDP/GNP per capita	$/person	
		Growth rate	%	
	Aggregate	Green Net National Product	$	
		Genuine savings	$	Hartwick (1990)
Socio-political	Single	Mortality	Deaths/1000	Pearce and Atkinson (1993) WRI, World Bank (1995), Sustainability Australia Report (2013)
		Literacy	Literacy rate/1000 people	
		Life expectancy	years	
		Population age structure	% of total pop	
		Urbanization	% of urban pop	
	Aggregate	Index of Social and Economic Welfare	$, or $/person	
		Genuine Progress Indicator	$, or $/person	
		Human Development Index	Index	

Adapted from Hanley *et al*. (1999) and Sustainability Australia Report (2013).

Table 2: Overview of Various Forces/Variables used in the Study of STRIPAT Model

Literatures	Driving forces (Variables) used at STIRPAT model											Results
	Dependent Variables	Explanatory Variables										
	I	P	A_1	A_2	D	Ta_1	Tb_1	Ta_2	Tb_2	**G**	**EI**	
Jia *et al*. (2009)	✓	✓	✓	✓	✓	✓	✓	✓	✓			P is the most dominant driver and the effect of the other drivers could almost be ignored.
Ping and Xinjun (2011)	✓	✓	✓	✓			✓					GDP per capita was the most dominant driving force of EF and classical EKC hypothesis did not exist between A and EF in 1998-2008.
Zhao (2010)	✓	✓	✓	✓		✓				✓		Population and using intensity was a major driver of ecological footprint.
Lin, Zhao and Marinova (2009)	✓	✓	✓			✓	✓				✓	Population has the largest potential effect on environmental impact, followed by urbanization level, industrialization level, GDP per capita and energy intensity.
Madu (2009)	✓	✓	✓				✓					Population and affluence impacts positively while urbanization affects negatively on environment.
Zarzoso, Morancho and Lage (2007)	✓	✓	✓			✓					✓	Higher environmental impact observed in less developed regions in European union during the period 1975-1997 using STIRPAT analysis.
Wang *et al*. (2011)	✓	✓	✓				✓					Population, affluence and urbanization level increase CO^2 emissions while energy intensity decreases.
Cole and Neumayer (2004)	✓	✓	✓			✓	✓					Population increases are matched by proportional increase in emissions while a higher urbanization rate and lower average household size increase emissions.
Shi (2003)	✓	✓	✓		✓	✓						The impact of population change on emissions is much more pronounced in developing countries than in developed countries (variable extra: service sector % of GDP)
Fan *et al*. (2006)	✓	✓	✓			✓					✓	The impact of population, affluence and technology on environmental varies at different levels of development.
Wei, Xianghao and Shaoquan (2011)	✓	✓	✓	✓	✓		✓					Population is the most important driving force of the EF. Urbanization and % of GDP from industry also have positive association with EF.

Notes: I denotes for Environmental Impact, described by per capita ecological footprint or CO_2 and GHG emission. P for total regional population, D refers to dependency ratio, A_1 (affluence) for GDP/GRP per capita, A_2 for quadratic term of GDP per capita ([log (GDP per capita)-Mean]^2), Ta_1 & Tb_1 (Technology) are the % of the economy not in service sector (Industrial share) and % of the urban population respectively. Ta_2 & Tb_2 Quadratic terms of of Ta_1 & Tb_1, EI refers to energy intensity to use, G denotes for grazing amount per lawn.

Table 3: Overview of previous literature reviews on ecological footprint and STARIPAT

Study	Method	Key findings
Liyan *et al*. (2007)	EF	The per capita EFs were always larger than the ecological capacities from 1990 to 200 in the Zhangjiakou City. So the city`s sustainability was deteriorating gradually.
Huang *et al*. (2007)	EF	Positive relationship between population changes and ecological demand in the three regions of Shaanxi Province.
Ying *et al*. (2009)	EF	Because of population growth and industrialization, the EF of Yunnan switched from a surplus into deficit in the 1990s and has increased rapidly during last decades.
Ping and Xinjun (2011)	EF & STIRPAT	The degree of sustainable development varied distinctly from city to city in YDR and DGP per capita was the most dominant driving force of EF, whereas the classical EKC hypothesis did not exit.
Wei *et al*. (2011)	EF, STIRPAT & Ridge Regression	Province was in a state of ecological deficit and unsustainable at the national scale. Population was the most significant effects on the ecological footprint in Sichuan Province followed by urbanization and GDP forces.
Scotti *et al*. (2009)	EF	People living in Piacenza uses an area that is more than nine times the biological capacity of it`s territory.
Bergh and Verbruggen (1999)	EF	Regional trade has an impact on ecological carrying capacity but literature did not highlight this issue for calculating EF.
Lenzen and Murray (2003)	Input-output based EF	In order to get detail picture of environmental sustainability of a region, the decomposition of EF into commodities, production layer and structural path are necessary.
Lei *et al*. (2009)	EF Trade	EF trade influences the level of regional sustainability.
Kitzes *et al*. (2007)	EF	EF measures how much bio productive land and sea area is available on earth and how much of this area is appropriate for human use
Mingquan *et al*. (2010)	EF & STIRPAT	Ecological footprint both on consumption and production increases because of excessive resources exploitation.
Dietz *et al*. (2007)	EF & STIRPAT	Population and affluence have considerable impact on environment.
Wackernagel *et al*. (2004)	EF	Austria`s ecological footprint was higher because of rapid industrialization.
Wood and Garnett (2010)	Life Cycle Approach	The environmental impact of urban populations is generally higher than that of remote populations in Northern Australia
Goodall, J. (2009)	Literature review	Sustainability is one of the hallmarks of many indigenous economics, but it cannot withstand the dynamics of economic growth and industrial development.
Wang and Bian (2008)	EF	The increasing tendency of ecological footprint in the study area from 1995 to 2003 and GDP is regarded as the indicator of regional sustainable development.
Kitzes *et al*. (2009)	Literature review	Still needs to improve the methodologies of calculation of ecological footprint so future research is inevitable.
EPA Victoria (2008)	EF Input-output	Ecological footprint is a key indicator to assess the environmental impacts of consumption. Victoria`s footprint is more than three times higher than the world average of 2.2 productive hectares per person.
Vic Urban (2007)	EF Input-output	The overall footprint of an average Aurora resident is approximately 9% les compared to a conventional 5 star development. If this saving could be replicated globally, humanity would be able to eliminate half of its current ecological impact.

Table 4: Overview of previous literature reviews on ecological footprint and STARIPAT

Study	Method	Key findings
Lenzen and Murray (2001)	Input-output EF	Considering actual land instead of hypothesized land in calculating ecological footprint, it shows Australia's ecological footprint is about 13.6 hectares per capita, which is larger than results obtained in previous studies.
Wackernagel and Yount (1998)	Literature review	EF assessments demonstrate that sustainability can be measured and it gives instructions for local, national and global efforts to close the sustainable gap.
Bagliani *et al*. (2008)	EF	The study area is characterized by a nearly breakeven total ecological balance, a result contrasting with the national average and most of the other Italian provinces
Chen *et al*. (2001)	EF	In 1981 to 2000 there was ecological deficit in China so measures were needed to decrease the deficit on the road to sustainability
Zhao *et al*. (2005)	Modified EF	At Gansu province in China, still runs an ecological deficit since 2000
Daily and Ehrlich (1992)	Literature review	Trade may increase biophysical carrying capacity through the increased efficiency that results from regional specialization in the production of goods
Rosa *et al*. (2004)	STIRPAT	In comparison to the impact of urbanization and geographical factors on environment, National affluence and GDP per capita has a strong effect on environment.
Lin *et al*. (2009)	STIRPAT	The population has the potential effect on environmental impact, followed by urbanisation level, industrialisation level, GDP per capita and energy intensity in the study area.
Madu I. A. (2006)	IPAT & STIRPAT	Population and affluence are the most important anthropogenic drivers of environmental impacts in Nigeria
Liddle, B. (2013)	STIRPAT	In developing countries, the demographic variables (population size and urban density) are particularly important in determining private transport energy consumption.
Lozano and Gutie'rrez. (2008)	Non-parametric frontier approach	Reasonable GDP growth rate are compatible with significant reduction in GHG emission level in USA
Shi, A. (2003)	STIRPAT	The impact of population change on emissions is much more pronounced in developing countries than in developed countries
Cole and Neumayer (2004)	STIRPAT	Population has impact on both in CO_2 and SO_2 emissions but in varies degrees.
Wang *et al*. (2011)	STIRPAT with scenario method	The increase of population, affluence and urbanisation level would increase CO2 emissions, but energy intensity decreases.
York *et al*. (2003)	ImPACT, IPAT & STIRPAT	The STAIRPAT model, allows for a more precise specification of the sensitivity of environmental impacts to the forces driving them
Romero Lankao *et al*. (2009)	STIRPAT	Population size is a significant driver, especially for cities SO2 emissions and transportation energy use, as it is in studies undertaken at the national level
Waggoner and Ausubel (2002)	IPAT	An annual 2-3% progress in consumption and technology over many decades and sectors provides a benchmark of sustainability
Ehrlich and Holdren (1971)	Litereture	Population growth causes a disproportionate negative impact on the environment

Measuring the Multidimensional Impact of Drought on Regional Capacity

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ABSTRACT

Drought has increasingly become a major issue in Australia and globally. Increased severity and longitude of drought and flash flooding are only predicted to get worse under expected climatic conditions. Whilst some countries are developing "plans" to reduce the impact of drought, the ability of communities to adapt and be resilient to drought, depends on the capacity and capability of the area. This study will look at the capacity of communities in the Murray Darling Basin, south east Australia to adapt to drought, specifically how their capacity changed as a result of the Millennium (2003-2009) drought. We create an index that can be used to differentiate the various determinates of capacity of areas to cope with the drought. Results indicate that areas with higher overall capacity adapted better to the drought, although the Murray Darling Basin suffered with higher income disparity and poverty rates compared to the nation.

INTRODUCTION

Under a changing climate, severe regional droughts have become more frequent triggering wide-scale impacts. Droughts are associated with prolonged periods of higher temperatures and decreases in water availability and have lasting impacts on; ecosystem disturbances (Banerjee *et al*, 2013), economic losses (Salami *et al*, 2009) and livelihoods (e.g. Reec *et al*, 2013). Importantly, these impacts are felt in developed (e.g. Fu *et al*, 2012) and developing countries (van Dijk *et al*, 2013; Beniston *et al*, 2007; IPCC, 2007).

Therefore many countries have been preparing to develop a plan to face the implication of drought such as in the US (Fu *et al*, 2013) and Mediterranean (Pérez-Blanco and Gómez Gómez, 2013). Although some plans' are being developed to reduce the impact of drought, the ability of communities to adapt and be resilient to drought depends on the capacity and capability of the area. This study will look at the adaptive capacity of areas in the south east Australia, specifically the Murray Darling Basin (MDB) area and how their capacity was affected by the decade of drought (2003-2009). This is important as the adaptive capacity such as socio-economic condition may not only determine how a society could adapt with the natural predicament like drought, but also the drought could affect the capacity of area. The example of the impact can be capture by the drought effect on the pattern of migration (Black *et al*, 2011) and even on increasing the rate of suicide (Hanigan *et al*, 2012).

The 'management of drought' raises four serious issues. First, there is no unified definition of drought. Second, there has been little recognition in the literature to date that in social-

ecological systems or human-environment connected systems the antecedent conditions of the system are critically important to how a system reacts to changed climatic conditions (O'Brien *et al*, 2004; Pearson *et al*, 2010). Therefore studies which do not understand the antecedent conditions and the extent of how interconnected the human and environmental system are will be uninformed on the potential outcomes/impacts of a drought. Third, there is growing recognition that 'management' of extreme natural events is contained to 'managing the impact' of extreme climatic conditions on the human systems – it is not about managing the actual natural event. Lastly, management is a practical tool that requires implementation, it is therefore necessary that measures of impact from these plans are developed that are practically useful and academically rigorous to support and enhance effectiveness of implementation of the plan (Nelson *et al*, 2007).

This study aims to measure the distribution of adaptive capacity in the Murray Darling Basin and address the following research question. How has the adaptive capacity of the MDB been affected by the Millennium Drought? To answer that question, this study is structured as follow. This introduction will be followed by a review on the drought in Murray Darling Basin area and a review on measuring adaptive capacity as section two of this study. We will then discuss the availability of data and measurement process. Section four will discuss at the result and section four will conclude this study.

DROUGHT IN MURRAY DARLING BASIN (MDB)

The southeast of Australia experienced the worst drought during 2001 to 2009 as the MDB suffered the longest uninterrupted series of years with below median rainfall in southeast Australia (see CSIRO, 2010). Whilst the MDB is a large area (over 1 million square km covering the catchment area of 23 rivers and tributaries) it supports a population of about 2.5 million people including Canberra and Adelaide. Emerging analysis and research is revealing that most of the basin was in severe drought this whole period (see van Dijk *et al*, 2013). This drought has brought many consequences for ecosystems (Murphy and Timbal, 2007), economy (Kirby *et al*, 2012) and society (Berry *et al*, 2010). Specifically the period 1997-2009 had the lowest average rainfall since 1900 (CSIRO, 2010), whereas surface water resource scarcity had already started to develop around 1994 (van Dijk and Renzullo, 2009). The end of the drought was more pronounced with significant rainfall and flooding to many part of the south eastern Australian, including the MDB in 2010.

Van Dijk *et al* (2013) outlines the various impacts the drought on southeast Australia. This includes the hydrological effect where it is not only the depletion in the amount of water that has become the concern but also the reduction of the stream flow of water that can affect the aquatic habitat as well as the sedimentation of the river. The hydrological impact directly affects the agricultural output in the Murray Darling Basin area. Kirby *et al*. (2012) shows the reduction in the production in cotton, rice, dairy and meat in the area during the drought followed by the reduction of employment especially in the cotton and dairy industry. This reduction has not only affect the Murray Darling Basin area but also spread to the Australia as well as world food supply (Qureshi *et al*, 2013). Nevertheless, the impact on the local economy was much stronger with the reduction in Gross Regional Product as well as employment (Horridge, 2002; Wittwer and Griffith, 2011).

Although the impact on the economy in terms of total gross product and employment has been observed, the analysis on the impact on the overall socio-economic condition is still lacking (van Dijk *et al*, 2013). This is despite a strong argument for the negative effect of drought on mental health as it affects the condition of settlement, increase the risk on physical health, endanger the environment, and affecting people livelihood (Berry *et al*, 2010).

Hanigan *et al*. (2012) confirms this argument by observing the suicide data in NSW during 1970-2007 and found the increasing level of suicide when the drought hit an area. The other condition that could indicate the impact of drought on socio-economic condition is the impact on migration (Black *et al*, 2011). The MDB migration is hard to detect, as Tonts (2005) observes, the migration out from the MDB has always been high since the 1990s especially the younger generation. However, Hunter and Biddle (2011) argue that the drought that has occurred in rural area especially during 2001-2006 has pushed a lot of the older generation out of the area as well.

MEASURING MULTIDIMENSIONAL ADAPTIVE CAPACITY

A regions capacity to adapt to drought is a contested issue. We see capacity or adaptive capacity as the ability to respond to external stimuli, in order to take advantage of the opportunities or moderate the damages, our external stimuli is drought (adapted from Gallopin, 2006; Brooks *et al*, 2005). Smit *et al*. (2006) outline the key criteria for capacity within a contextualised understanding of adaption. To summarise, overall capacity is context-specific and varies by place, scale and entity. Variation occurs in terms of its value (i.e. how large, small, significant) but also its nature (which other factors are affected etc.). Taking a systems approach we recognise that all aspects of capacity are interdependent and as such are related to the degree of embededness of the human system within the environmental systems resources and processes.

Eakin and Lemos (2006) have identified seven determinants of adaptive capacity; human capital, information and technology, material resources and infrastructure, organisation and social capital, political capital, wealth and finical capital and institutions and entitlements. Theses determinates are based on the livelihoods approach to capacity (e.g. Pearson *et al*, 2010) and are critically important for large heterogeneous studies in which magnitude and direction of each determinate changes significantly – this is most common in developing countries. In areas with homogenous distribution of any of these determinates, e.g. same strength and persuasion of political institutions, these determinates can be held stable and as such unnecessary to measure, providing a need to focus more closely on the other determines of capacity.

The MDB is contextualised as homogenous in its information and technology, political capital, and institutions and entitlements – ensuring that our investigation focused on the determinants that are most likely to be affected by drought; human capital, material resources and infrastructure, organisation and social capital and wealth and financial capital. Table 1 below summarises the determinants, and proxy measures used in this study, with further explanation in the next section.

Table 1 shows that the adaptive capacity is multidimensional and therefore needs to be represented by multiple indicators. However, the measurement of multiple indicators can be difficult to interpret as we may be able to say whether income as one indicator was high but if it combines with low human capital the combination will be difficult to analyse and ascertain clear conclusions. Therefore we need indexes, composites of individual indicators, to provide a summary measure for an area and allow some simplified analysis. So the indexes can be used as a type of ‘litmus test’ for an area, to highlight areas that are experiencing drop in capacity.

One significant issue in constructing a composite index is determining an appropriate aggregation strategy to combine multidimensional variables. The previous efforts to formulate area-level socioeconomic characteristics in a multivariate context did not essentially agree on any single methodology for aggregation and weighting. Therefore, this paper uses the Factor

Analysis procedure for constructing a composite index to assess the regional impact of draught in the MDBA. Factor analysis encompasses both the Principal Component Analysis (PCA) and Principal Factor Analysis (PFA). Principal Component Analysis (PCA) is one preferred statistical method that has developed over the past decade. It is a method to try and organize the data to reduce its dimensionality with very little loss of information in the total variability of the chosen variables (Vyas and Kumaranayake, 2006; Giri, 2004). Recently, there is substantial evidence of research using PCA to develop area socioeconomic indices (Abello *et al*, 2012; Tanton *et al*, 2010; Krishnan, 2010; Harding *et al*, 2009; McNamara *et al*, 2009; Havard *et al*, 2008; Messer *et al*, 2008).

Table1. Determinants of Adaptive Capacity in the Murray Darling Basin with Proxy Measurement Indicators

Determinants	**Indicators**	**Indicator description**
Human capital	1. Proportion of population with Bachelor Degree level or above 2. Proportion of population with Advance Diploma 3. Proportion of population with Certificate level 4. Proportion of population with Year12 qualification	Although human capital can include health and experience, levels of education are common proxies of human capital especially because the level education has a more universal measure.
Material resources and infrastructure	1. Total number of Occupied Private Dwellings 2. Median Value of Occupied Private Dwellings	Given the different infrastructure necessity in different location, this study focuses on the number of dwelling and its value.
Organisation and social capital	1. Internet access 2. The ability of multiple languages 3. Proportion employed in the agricultural sector 4. Proportion employed in the Retail, trade and service sector 5. Herfindahl index	Showing the level of connectedness in the society and to the outside of the area. Organisation in this term is related to socio-economic structure.
Wealth and financial capital	1. Gini Index 2. Poverty rate 3. Employment level.	These indicators reflect the relative income or disparity of income.

PCA is an approximation to PFA particularly if the factors are rotated. One important distinction between the two techniques is that PCA is based on the assumption that all variability in a variable should be used in the analysis, whereas PFA only accounts for the variability in a variable that is common with all other variables. While both PCA and PFA mostly produce similar results PFA is used to identify the structure of the existing data rather than for data reduction purpose.

DATA

The data used for the indicators and indexes in this paper came from the latest 2011 and 2001 Census of Population and Housing from the Australian Bureau of Statistics (ABS). The census is carried out in Australia once in every five years. However, in order to cover the period of draught in this region over the past decade we have used two concurrent census periods 2011 and 2001 for comparative prospective.

The geographical unit of analysis for this study is the Statistical Local Area (SLA). SLAs are part of the ABS Australian Statistical Geography Classification (ASGC). The Australian Standard Geographical Classification (ASGC) is being progressively replaced by the Australian Statistical Geography Standard (ASGS) from the 2011 Census onwards. However, in this research we have used SLAs from ABS ASGC to facilitate comparison over the draught period with 2001 census. SLA is the statistical area based on Local Government/Council Areas or LGAs boundaries. Some SLAs covers the whole LGA while others are parts of a particular LGA. SLAs cover the whole of Australia without gaps or overlaps (ABS, 2011). They are small enough to provide the detail required but large enough to have data available.

Another geographical unit used in this study is the remoteness area. This geographical unit is considered important as it indicates the level of accessibility that in turn affects government service delivery. The unit is an aggregated form of the ARIA index which was built by the then GISCA, currently the University of Adelaide's Australian Population and Migration Research Centre (APMRC), based on road travel distances (ABS, 2001).

Based on this we have put together information on a set of available indicators under each of the above stated broad domains. This is informed by research on factors known to be important for analysing the impact of draught in small areas. The choice of indicators is also based on the policy relevance of the variables and the availability of the data at the SLA level to quantify the required dimensions. Human capital is a capacity indicator that can be sourced from census data. In the census, this could be represented by the non-school qualification that describes the highest level of a non-school qualification. In particularly, this study uses the proportion of those with Bachelor degree and above, Advance Diploma and Certificate as their highest level of qualification. This variable is applicable only to person aged 15 and above and therefore, the proportion is calculated based on that population group. In addition, the proportions of those who have not acquired their non-school qualification but has completed year 12 are also identified as human capital indicator.

Another important capacity is the material resources and infrastructure. Given the different infrastructure necessity in different location, this study focuses on the number of dwelling and its value. Dwelling is defined in the census as a structure where people intend to live such as houses, caravans, tents, and houseboats. In particular, the dwelling that privately occupied (OPD) is the one that are calculated so it excludes hospitals and hotels. Although the census of population and housing has question about rent and mortgage, there is no information about the value of the housing itself. Therefore, the value of the dwelling is proxy by the median house price index based on RP Data median house prices. RP Data house prices include all residential dwellings sold during the year.

Social capital is another aspect that considered important in the capacity measure. This capital shows the level of connectedness in the society and to the outside of the area. Internet access and the ability of multiple languages are the main indicators for this capital. In addition, the employment level is also considered as people are also connecting to each other in the workplace. All these three variables are available in the census. For the multiple languages,

the indicator is the proportion of those who can speak English well and have the ability to speak other language while for internet connection, the proportion of dwelling that have access to broadband connection become the indicator.

The spread of employment by industrial sector is the variable from census of population and housing to measure the industry concentration. Three types of measures are used to look at the concentration the first one is the proportion of people working in agriculture sector as the main employing sector in this mainly agricultural area. The second one is the proportion of people working in the retail and hospitality sector. The second variable may be controversial but the existence often seen as the sign of the existing economic transformation in an area and especially for rural community it provides the opportunity for young people to break into the job market (Kilpatrick *et al*, 2011). The third indicator is the Herfindahl index. The index is the sum of the squared employment proportions of the entire industrial sector in the area. Weinstock (1985) notes that the index was increasingly used to provide a more complete picture of the market compared to the proportion of several highest industrial sectors.

The wealth and financial capital will be represented by the measure that reflecting relative income or disparity of income. Relative poverty rate is the indicator to measure the income disadvantage of the area compared to the rest of Australia. The poverty line is set at 50 per cent of the median equivalised household income, so that all persons with household income falling below this figure are deemed to be in poverty. The equivalised total household income is the adjusted value of household income by the scale based on the number of adults and children in the household (see Atkinson *et al*, 1995 and Saunders *et al*, 2008). Given this measurement apply to the disposable income, the rate has to be estimated using spatial microsimulation as the census does not provide the disposable income (see Tanton *et al*, 2009 for further detail on poverty rate calculation using spatial microsimulation). Besides the measure of relative financial wealth to the rest of the country, we also look at wealth and financial disparity within the area, this study estimate Gini coefficient of the equivalised total household income that calculated using sptial microsimulation based on Census data (see Harding 1997 for further detail on Gini calculation).

To ensure that the data we were using in the indicators and indexes were reliable, we have excluded any areas with no information available on at least one of the selected indicators. There are some SLAs where an estimate cannot be produced by Spatial microsimulation model, since the estimation process does not achieve an acceptable error for the estimate (see Tanton *et al*, 2011 on the total absolute error (TAE) in spatial microsimulation models as a criterion for reweighting accuracy).

MEASUREMENT PROCESS

The initial rounds of PCA and PFA results shows that putting all the indicators into the process will result the loading of the indicators can be separated into two grouped. The first group includes the four proportions of person with certain education level and the two indicators related to dwellings. This means the indicators related to human capital and infrastructures are located in this group while the second group contains proportion of employed population, gini index, poverty rate, proportion employed in the agricultural sector, proportion employed in the retail, trade and service sector and Herfindahl index. Two variables related to social capital – internet access and the ability of multiple languages – have not produce a convincing relationship with neither of the two groups.

The next rounds of PCA and PFA are applied for each of these two groups separately. In this process there were two consistently identified underlying constructs both for 2001 and 2011 analysis that separate human capital and infrastructures indicators as their own group. PFA on

this Capital based construct identified Human Capital as the primary factor and Material resources and infrastructure as the secondary factor in both 2001 and 2011 analysis of the regions.

Likewise, there were two consistently identified underlying constructs both with 2001 and 2011 analysis for the second group of indicators. The first includes proportion employed in the agricultural sector, proportion employed in the Retail, trade and service sector and Herfindahl index. Therefore, we renamed it as employment concentration index. The proportion of employed population, Gini index and poverty rate also produce as distinct index and we name it wealth and financial disparity. PFA on the Disparity based construct identified Employment Concentration as the primary factor and Wealth and financial disparity as the secondary factor in both 2001 and 2011.

The four factors or indexes – human capital, Material resources and infrastructure, Employment Concentration and Wealth and financial disparity – are then combined into one composite index that can give the picture of the overall adaptive capacity. These entire four indexes are given the same weight or considered to have the same level of importance. Nevertheless, the direction of the index produced is different. For example from the human capital index the higher the index indicates the better the adaptive capacity will be while in the Wealth and financial disparity the higher the index shows the lower adaptive capacity. Therefore, we give a negative weight toward wealth and financial disparity while positive for human capital. Another index that is given negative weight is Employment Concentration.

RESULT AND DISCUSSION

Table 2 shows the MDB and National averages for each of the indicators, as well as the minimum and maximum values in the MDB, for 2001 and 2011. It can be seen that the proportion of people with a bachelor degree and above is increasing in the MDB, but this is a national trend. The ratio of the national average to the MDB average shows that the increase in the MDB has been slightly lower than the national increase; however, the increase in Certificate level in the MDB has been higher than the national increase, with the proportion having a certificate level qualification in the MDB being about the same as the national average (about 20 per cent). This does suggest that there has been a trend nationally towards bachelor degrees which has not been followed to the same extent in the MDB, with people in the MDB getting certificates instead.

In terms of employment, from 2001 to 2011, employment rates have increased slightly both nationally and in the MDB, and there is not much difference between employment rates nationally and in the MDB. The employment rate in the MDB has gone from being slightly above the national average in 2001 to being slightly below the national average in 2011. This could be due to the drought, but could also be demographic change, as older people in the basin retire and are not replaced by younger people staying in the basin.

One of the interesting results from Table 2 is the Gini coefficient, which has increased in the MDB at a much faster rate than nationally. The Gini coefficient is a measure of the difference between the rich and poor. In 2001, the Gini coefficient in the MDB was similar to the national – about 3 per cent lower. By 2011, it was 21 per cent higher than the national. So in 2011, there was a much greater difference between the rich and poor in the MDB. This could be due to farmers experiencing much lower incomes as a result of the drought, but miners in the MDB experiencing much higher incomes, so the disparity between the incomes of these two groups has led to a much higher Gini coefficient in 2011.

Looking at the final indicator, poverty rates, it can be seen that national poverty rate declined from 2001 to 2011, while the poverty rate in the MDB declined only slightly. Compared to the national poverty rate, the MDB poverty rate went from being 5 per cent above the national poverty rate in 2001 to 20 per cent above in 2011. This is probably due to the drought over this period.

Table 2: Average Values for Indicators, Murray Darling Basin and Comparison to the Australian Nation

	Year	National average	MDB Min	MDB max	MDB Average	Ratio National to MDB
Bachelor Degree Level and above (%)	2001	14.59	3.38	25.90	10.29	0.71
	2011	21.15	4.72	33.99	14.44	0.68
Certificate Level (%)	2001	17.80	8.23	21.56	15.87	0.89
	2011	20.28	10.98	27.21	19.93	0.98
Employed (%)	2001	58.33	36.41	82.27	59.14	1.01
	2011	61.38	38.04	80.82	61.03	0.99
Gini Coefficient	2001	0.31	0.08	0.48	0.30	0.97
	2011	0.39	0.06	0.65	0.47	1.21
Below 50% of Equivalised Household Disposable income (%)	2001	14.12	7.30	66.06	14.81	1.05
	2011	12.33	4.90	28.40	14.75	1.20

The next step was to turn these indicators into an index. This was done using the PCA method described above, and Figure 1 shows the overall results for the MDB. This figure shows the proportion of areas in each quintile of the index by ARIA classification in 2001 and 2011. Because we are using quintiles of the index, each quintile has 20 per cent of the areas.

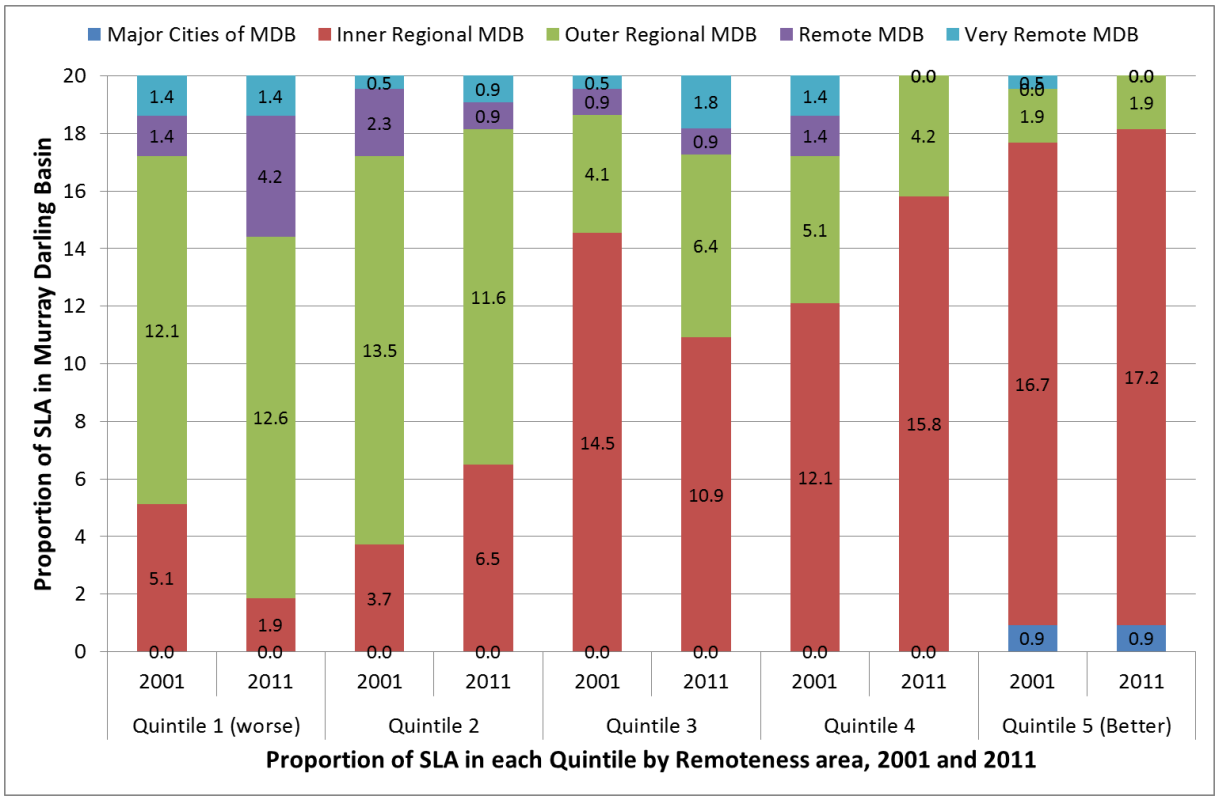
The interesting story from this graph is the change from 2001 to 2011. It can be seen that for inner regional areas, there is a reduced proportion with low capacity in 2011, from 5.1 per cent in 2001 to 1.9 per cent in 2011; and an increased proportion in Quintile 4 (from 12.1 per cent in 2001 to 15.8 per cent in 2011). For remote areas of Australia, there is a much higher proportion of areas in quintile 1 (from 1.4 per cent in 2001 to 4.2 per cent in 2011) and a much reduced proportion in quintile 4 (from 1,4 per cent in 2001 to 0 per cent in 2011). Outer regional Australia has not changed much from 2001 to 2011; and major cities in the MDB (Canberra) have not changed at all.

What this suggests is that it is remote areas in the MDB that were affected most by the drought in terms of their capacity. Inner regional areas actually had higher capacity after the drought, possibly due to the mining boom. It should also be remembered that all these indicators are relative – so a better indicator shows that an area has got better compared to all other areas. It may not have got better – it may have stayed constant while all other areas got worse. This may explain the increased proportion of inner regional areas in Quintile 4 in 2011 – it may be just that the remote areas got worse, which moved the relative position of the inner regional areas up.

The other factor that may account for this is that inner regional areas may have more opportunity for non-farm employment, so employment that is not affected directly by the drought. While secondary effects of the drought affect all sectors in an area, it could be that in inner regional areas in the MDB, people could travel to a larger regional centre for work, thus protecting their income and employment, key factors in our index of capacity.

Another interesting story in Figure 1 is that Quintile 5 has not changed much at all from 2001 to 2011. This suggests that these might be areas that have strong protective factors that were not affected by the drought – for example, industries that aren't affected by drought. There were very few Very Remote areas in Quintile 5.

Figure 1: Results from the Index of Capacity



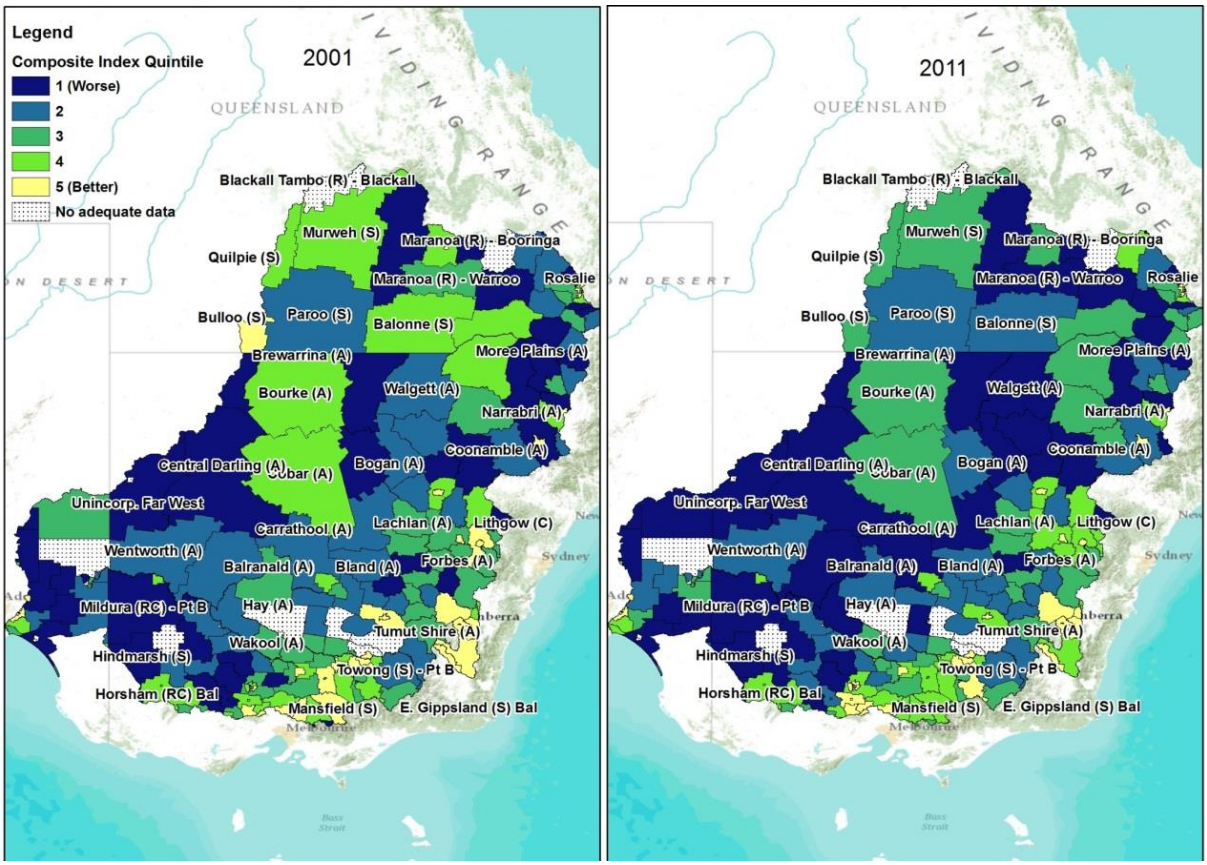
Having looked at the results broadly, the next step is to identify where these areas were, and we have done this using choropleth maps. The maps show the index across the whole of the Murray Darling Basin based on statistical local areas. The map classifies the SLAs in the MDB based on the quintiles of the composite index. A higher index indicates that the area would have a relatively better capacity to adapt to change than other areas within Murray Darling. In our maps, the lighter colour indicates this better adaptive capacity. The classification is based on quintiles, so there are an equal number of areas in each quintile. We have used an equal number of areas in each quintile rather than an equal number of people in each quintile because we are interested in the characteristics of the area and many of our indicators are associated with the area rather than people in the area.

Note that as we compare over time, there are two things changing – the weights for each of the indicators forming the index, and the value for the indicator in that SLA. We have not separated these in this analysis, on the basis that any change in the weights will be due to MDB effects; and local effects will be reflected in changes to the SLA level indicators.

Figure 2 shows the spatial distribution of the composite index in 2001 and 2011. In 2001, the areas with the greatest level of adaptive capacity are located mostly around Canberra and the areas bordering north of Melbourne and the Blue Mountain in West of Sydney. Figure 1 shows that some of areas with the next highest value (Quintile 4) can be found near to those areas, so there is a progression of adaptive capacity as we move away from the capital cities. Having said this, some areas in Quintile 4 are in the more remote area of the Murray Darling

Basin region such as Cobar Bourke, Balonne, Moree Plains and Murweh in the North of the Basin. The areas with lowest level of adaptive capacity (Quintiles 1 and 2) are mostly in the very remote area of NSW bordering with South Australia and the outer regional areas in Victoria, NSW and South Australia.

Figure 2: The Murray Darling Basin Map of Adaptive Capacity Composite Index



The 2011 map on the right of figure 2 shows the adaptive capacity after a decade of drought. It is important to note that the adaptive capacity is measured relative to other areas in the Murray Darling Basin. Figure 2 shows a noticeable impact of drought on the remote and outer regional areas. The relative adaptive capacity of Cobar, Bourke, Moree Plains and Murweh has decreased from 2001 to 2011. However, the impact on those areas with high values in 2001 has not been as great while Balonne has got a lot worse from Quintile 4 to 2.

Another impact that can be seen in the two figures is that the drought has made the adaptive capacity more concentrated in particular areas. Areas that had a lower level of capacity in 2001 are showing as getting worse after the drought has struck. On the other hand, there are some improvements to areas close to the capital cities with the exception of areas surrounding Mansfield in the north of Melbourne and Eden-Monaro in the south-east of Canberra.

The period that we are looking at in these maps (2001 – 2011) covered a period of drought in most of the areas analysed. This is reflected in the change in the indexes and indicators over this period.

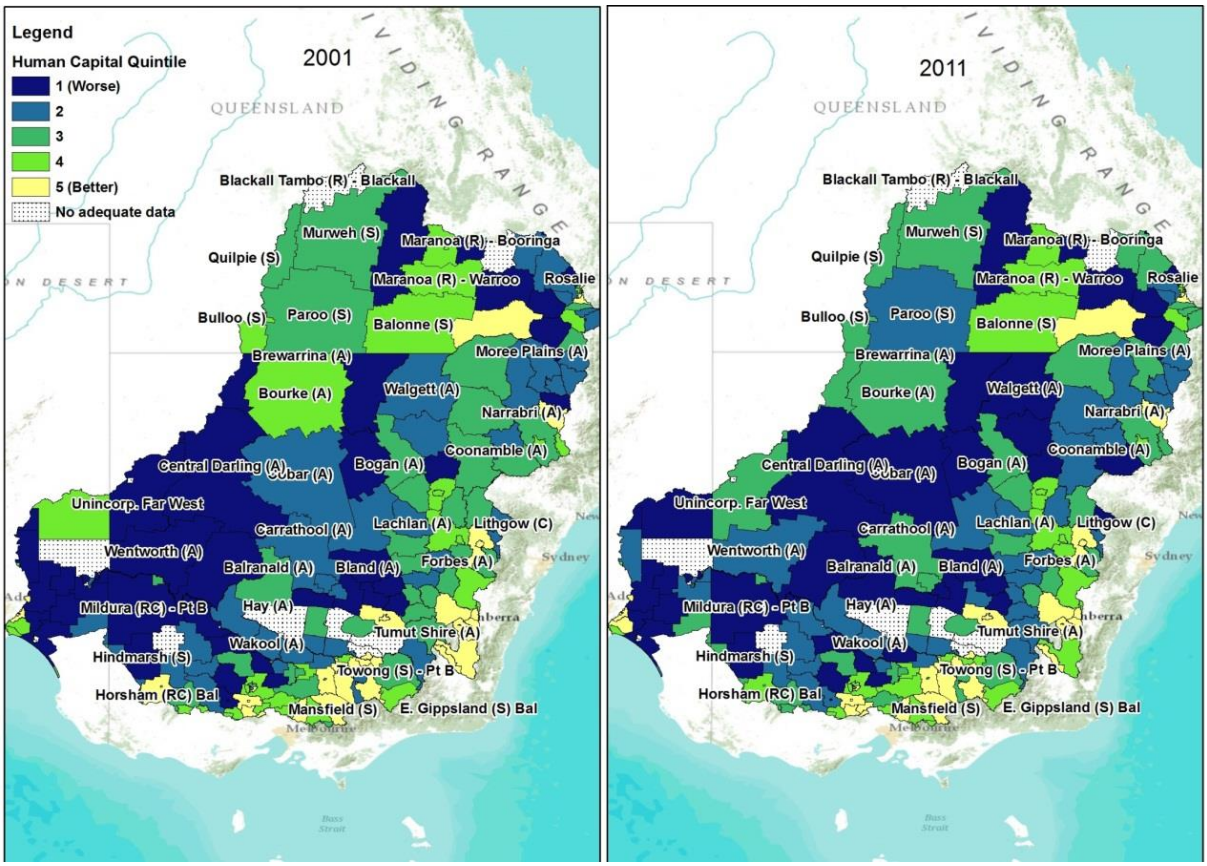
The analysis of the composite index above confirms two theories. First, that the areas with lower overall adaptive capacity were more vulnerable during the drought and second, that after the drought the areas with higher capacity are more concentrated near the capital cities.

This could be for two reasons. It may be because the cities are able to provide employment in times of drought, so farmers or their family get jobs in the cities and travel. The other reason could be that people living in these areas already have jobs in the cities, and they live in the area for a rural lifestyle close to the city for work.

The composite index cannot provide any information on the type of capacity that has been affected by the drought. As has been discussed in the index construction section, the composite index is actually calculated from four components –human capital, material resources and infrastructure, wealth and financial disparity and employment concentration. Analysing how these four components change during a decade of drought will provide better insight into the type of capacity that was affected by the drought.

Human capital capacity is the first component to be analysed. Figure 3 indicates that the reduction in human capital does contribute to the reduction in the overall capacity, especially in the outer regional areas of NSW and Queensland. Cobar, Bourke, Walgett, Paroo and Murweh are among the areas where human capital decreased from 2001 to 2011. The highest reduction in human capital seems to be found in Hay. One demographic factor that could affect human capital is migration (Black *et al*, 2011). This particularly affects younger people moving out from rural areas (see Hunter and Biddle, 2011). This argument is supported by data that shows Hay and other areas with a high loss of human capital were also areas with the highest net out migration during 2006-2011.

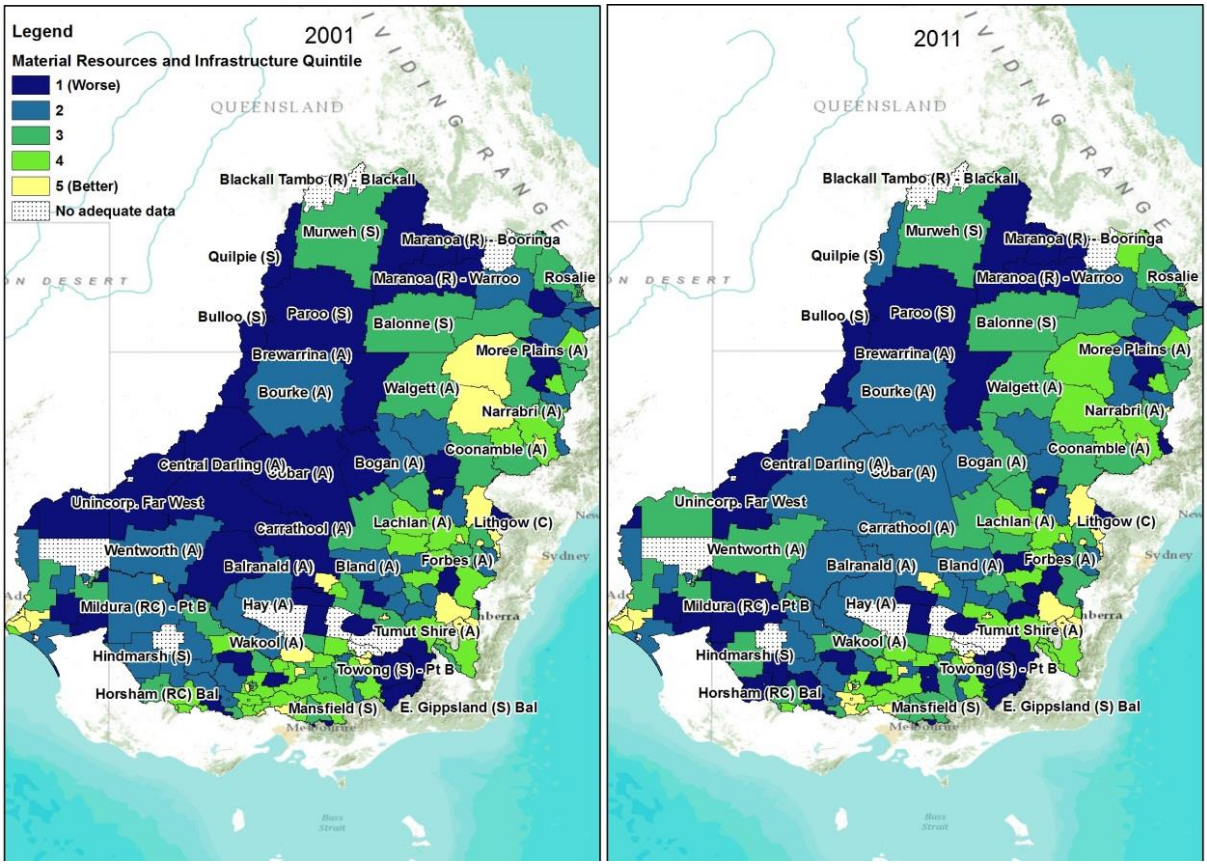
Figure 3: The Murray Darling Basin map of human capital Index



This plausible migration story is ironic when compared to the relative improvement of the material resources and infrastructure around those outer regional areas. Figure 4 shows that some areas where human capital reduced were areas where material resources and

infrastructure has got better. The material resources and infrastructure index is measured based on the number and value of occupied private dwellings in the area. In 2001, those areas such as Cobar and Balranald were among the areas with the lowest value for material resources and infrastructure. The data shows that the increase in the relative material resources and infrastructure during 2001-2011 in these areas was more driven by the increase in the value of occupied private dwellings rather than the number of occupied private dwellings.

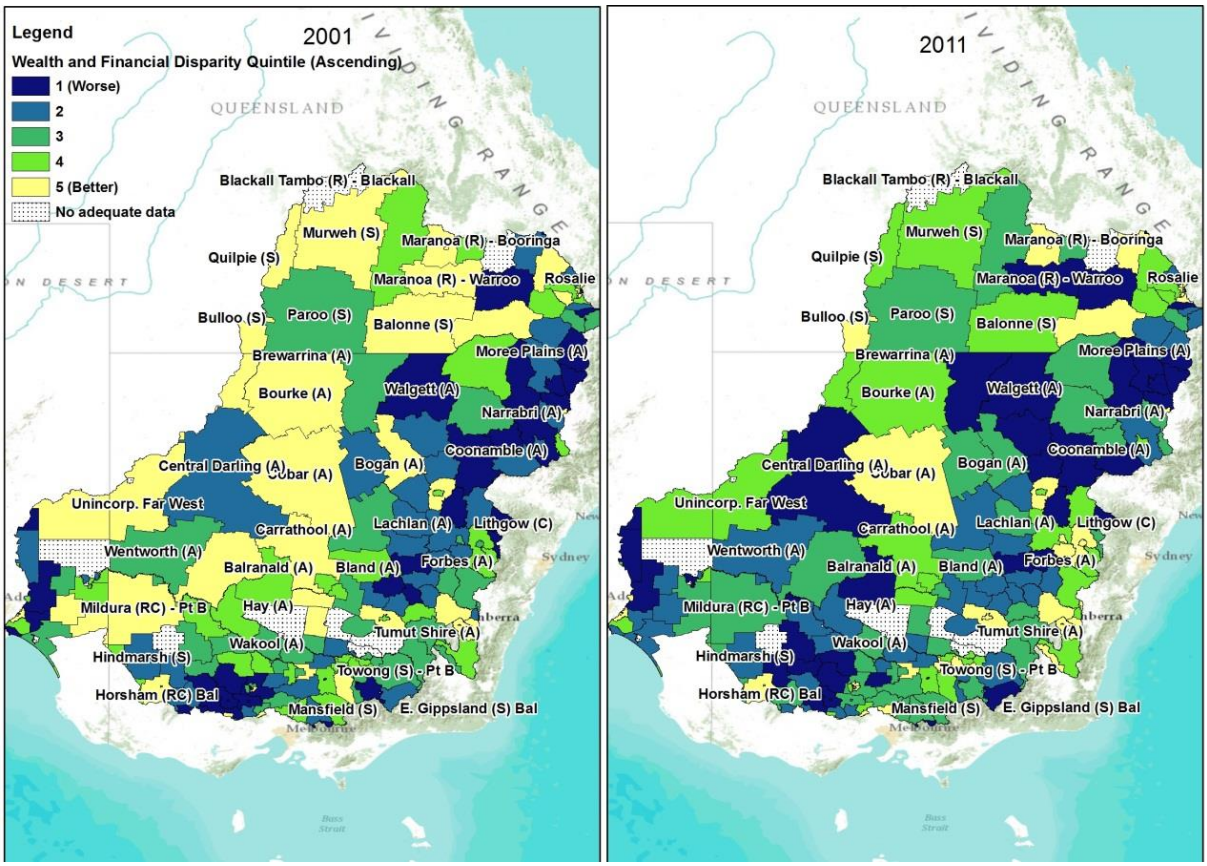
Figure 4: The Murray Darling Basin Map of Material Resources and Infrastructure Index



The other component that is likely to drive down the composite index in the outer regional areas is wealth and financial disparity index. The index of wealth and financial disparity is based on the disparity of incomes within the area as well as poverty rates (so incomes compared to a half national median income). This index shows that the outer regional areas were in a relatively good position in 2001 before the drought hit (Figure 5). Murweh, Balonne, Bourke, Cobar, Balranald and Mildura are in the highest quintile of the index in 2001. The decade of drought has brought down the wealth and financial disparity index in these areas. With the continuous impact of drought on various agriculture products (Kirby *et al* 2012, Qureshi *et al* 2013), the impact of the drought on incomes in an area can be calculated. Horridge *et al*. (2005) has estimated that gross regional product (GRP) was reduced by around 15 per cent in the first year of the drought with the South west of Queensland (Paroo, Balonne, Murweh, Maranoa) and North West NSW (Bourke, Walget, Cobar, Bogan) being the hardest hit with a 21 per cent and 18.4 per cent GRP contraction, respectively. Employment was also reduced by around three per cent in that first period (Horridge *et al*, 2005) and this has continued. Wittwer and Griffith (2011) estimated that

during 2006–2009 there could be another contraction of about 6 per cent in Southern Murray with the area around Mildura, Balranald and Carrathool the hardest hit. The inequality measure used in this capacity index measure also shows that the disparity in income, especially in agricultural areas, has also been increasing.

Figure 5: The Murray Darling Basin map of wealth and financial disparity Index



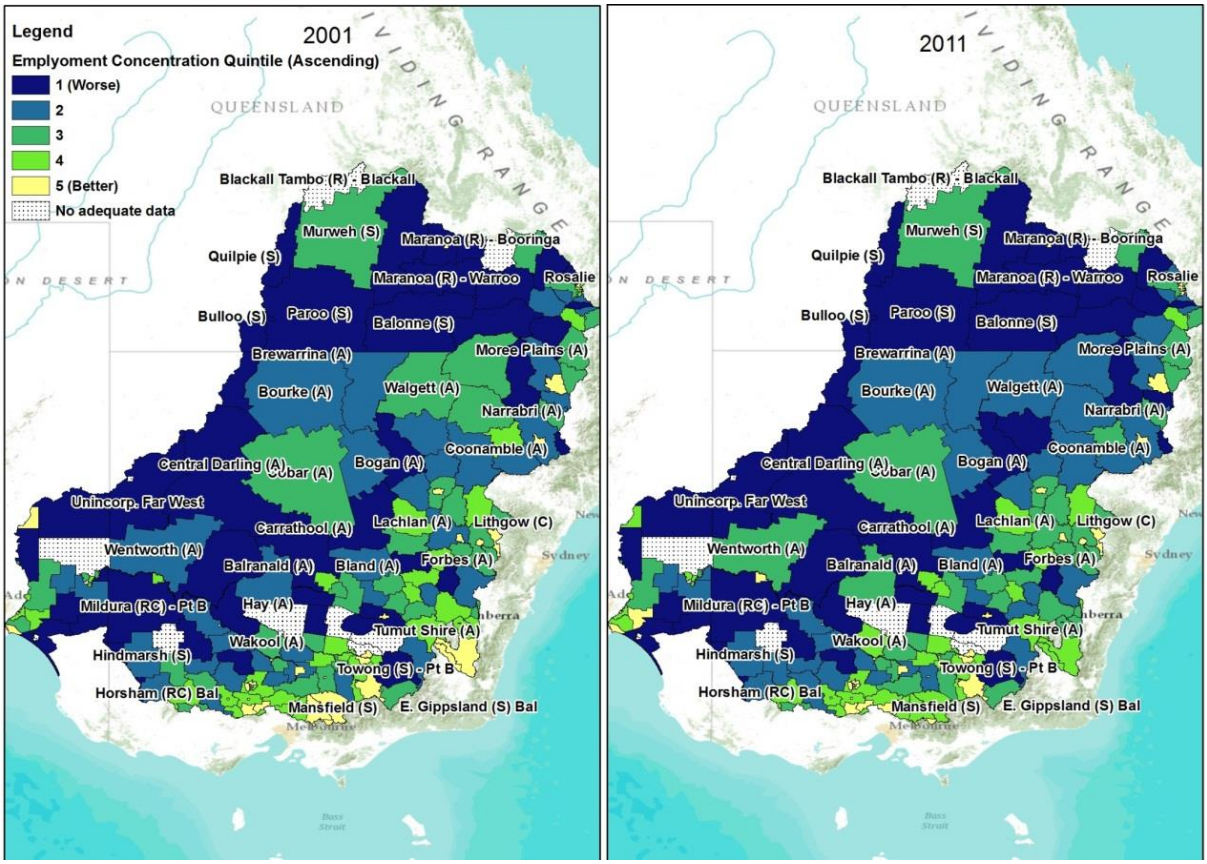
Despite the drought hitting the agricultural sector the most, Figure 6 shows that employment concentration has not changed much between 2001 and 2011. Despite this, there is an interesting pattern observed in the index, and this is that the employment concentration in Canberra and surrounding regions is worsening. This includes Eden Monaro, Yass, Palerang and Queanbeyan. In this case it is not about the agricultural sector but about the dependency on public administration. After the drought the proportion of employment in public administration actually increased in Canberra from around 25 per cent to 30 per cent while in Palerang and Queanbeyan it increased from around 15 per cent to 25 per cent.

CONCLUSION

This study aimed to measure the distribution of adaptive capacity in the Murray Darling Basin. It achieved this by answering the research question 'How has the adaptive capacity of the MDB been affected by the Millennium Drought?' In absolute terms the MDB has increased its income disparity, increased poverty rate and has not gained the same level of education as the nation during the Millennium Drought. Relatively within the MDB, the remote areas were affected most by the drought in terms of their overall capacity, whilst inner regional areas actually had higher capacity after the drought, possibly due to the mining boom. Areas that seemed to fair the worst were not particularly irrigation areas e.g. Bourke

was worse off in 2011; but Central Darling was no difference from 2001 to 2011. This does suggest that the indicators we have chosen don't just reflect irrigation water availability but het overall socio-economic capacity.

Figure 6. The Murray Darling Basin Map of Employment Concentration Index



These results were ascertained by the construction of an overall capacity index which was based on four determinates of capacity, as identified in Eakin and Lemos (2006); human capital, material resources and infrastructure, organisation and social capital, wealth and finical capital. Due to responsiveness for the index and its ability ascertain overall community capacity (rather than direct water shortage issues) its construction and development is a proof-of-concept for other catchments to use in their drought planning tools. Additionally, as the index was constructed form publically available data it can be readily updated and interrogated to provide further advice to policy makers in the management of 'drought plans'.

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