Socio-economic Vulnerability Assessment of the South East Queensland Horticultural Sector

Key Points

What's at Stake?

- More than one-third (37%) of Queensland's horticultural workforce lived in South East Queensland in 2011.
- 29% of the gross value of Queensland's horticultural production occurred in the region (2010-11).

Potential Vulnerability

- The horticultural sectors in the Lockyer Valley and the area between Caboolture and Beerwah are characterised by high potential vulnerability to the impacts of climate change.
- When compared to other parts of the region, the potential vulnerability of these two areas is revealed by the intersection of several lines of evidence, including: a) the highest percentages of the labour force employed in horticulture; b) the highest contributions to the regional value of horticultural commodities produced; c) higher levels of socio-economic disadvantage; c) less diverse local economies; and d) workforces with high percentages of owner managers aged 25-54 years and younger-aged employees.

Implications for the Future

- The close proximity of the Lockyer Valley and Caboolture horticultural sectors to services and infrastructure suggests that they are well-positioned to be able to capitalise upon increased demand for food driven by emerging social, economic and environmental trends (e.g., growing domestic and international populations; increased size of the middle classes in Asia; and the burgeoning health food industry).
- The same social, economic and environmental trends suggest that these opportunities may only be realised if horticulturalists can successfully navigate: a) increased competition for resources (e.g., energy, water, land); b) an ageing workforce; and c) a workforce that resides in areas of increasing socio-economic disadvantage.

Introduction

This commentary reports an assessment of socio-economic vulnerability to the impacts of climate change focusing upon the horticultural sector in the South East Queensland (SEQ) Natural Resource Management (NRM) Region. The agricultural focus of the vulnerability assessment was guided by the premise that economic sectors and populations which are more dependent upon natural resources are likely to be more sensitive to climate change impacts than sectors and populations which are less dependent upon natural resources.[1]

This commentary should be read alongside the SEQ NRM Region Horticultural Sector Fact Sheet.[2] Appended to this commentary are a set of maps that show the 2010-11 regional distribution of various characteristics of the sector (Maps 1-7).[3] When combined, the maps provide a snapshot of the sector's potential vulnerability to the impacts of climate change.

The assessment is then contextualised against six megatrends. "A megatrend is defined as a major shift in environmental, social and economic conditions that will substantially change the way people live" (Hajkowicz et al., 2012). Each megatrend is discussed in terms of how it may influence the potential vulnerability of the horticultural sector in the future. The six megatrends were identified by CSIRO in the report *Our Future World: Global megatrends that will change the way we live* (Hajkowicz et al., 2012). These megatrends are: a) More from less; b) Going, going… gone?; c) The silk highway; d) Forever young; e) Virtually here; and f) Great expectations.

It is recommended that this commentary be read and interpreted in the context of more detailed knowledge of local circumstances.

What's at Stake?

The SEQ horticultural sector comprises three subsectors: a) Vegetable Growing; b) Nursery & Floriculture Production; and c) Fruit & Tree Nut Growing.[4] In 2011, only 0.3% of the total SEQ labour force was employed in horticulture. However, when viewed within Queensland's and Australia's wider horticultural industry, the SEQ horticultural sector has greater importance than its small contribution to regional employment suggests. In 2011, 10% of Australia's horticultural workforce lived in SEQ, which represented more than a third (37%) of Queensland's horticultural workforce (Figure 1). Similarly, in 2010-11, 8% of Australia's gross value of horticultural production occurred in SEQ, or 29% of the gross value of Queensland's horticultural production (Figure 2).

Vegetable Growing

Almost one-third (30%) of Australia's Vegetable Growing workforce lived in Queensland. The SEQ Vegetable Growing workforce represented 42% of the Queensland Vegetable Growing workforce, which equated to 13% of the national Vegetable Growing workforce (Figure 3). Queensland produced almost one-third (32%) of Australia's value of production from Vegetables for Human Consumption. Almost one-third (32%) of Queensland's value of production from Vegetables for Human Consumption was from SEQ, which represented 10% of the national value of production (Figure 4).

Nursery & Floriculture Production

Almost one-quarter (23%) of Australia's Nursery & Floriculture Production workforce lived in Queensland. The SEQ Nursery & Floriculture Production workforce accounted for 61% of the Queensland Nursery & Floriculture Production workforce, which represented 14% of all Australians who worked in the Nursery &

Figure 1 Place of Residence by Percentage of the Australian Horticultural Workforce (2011)

Figure 2 Place of Production by Percentage of Australia's Gross Value of Horticultural Commodities Produced (2010-11)

Figure 3: Place of Residence by Percentage of the Australian Horticultural Workforce (Vegetable Growing)

Figure 4: Place of Production by Percentage of Australia's Gross Value of Horticultural Commodities Produced (Vegetables for Human Consumption)

Floriculture Production sector (Figure 5). Queensland produced almost one-quarter (23%) of Australia's value of production from Nurseries, Cut Flowers & Cultivated Turf. The majority of Queensland's value of production from Nurseries, Cut Flowers & Cultivated Turf was from SEQ (63%), which represented 15% of the national value of production from Nurseries, Cut Flowers & Cultivated Turf (Figure 6).

Fruit & Tree Nut Growing

Just over one-quarter (27%) of Australia's Fruit & Tree Nut Growing workforce lived in Queensland. The SEQ Fruit & Tree Nut Growing workforce accounted for 27% of the Queensland Fruit & Tree Nut Growing workforce, which represented 7% of all Australians who worked in the Fruit & Tree Nut Growing sector (Figure 7). Queensland produced just over one-fifth (21%) of Australia's value of Fruit & Nut production. SEQ contributed 15% of Queensland's value of agricultural production from Fruit & Nuts, which represented just 3% of the value of national production from Fruit & Nuts (Figure 8).

Figure 5: Place of Residence by Percentage of the Australian Horticultural Workforce (Nursery & Floriculture Production)

Figure 6: Place of Production by Percentage of Australia's Gross Value of Horticultural Commodities Produced (Nurseries, Cut Flowers & Cultivated Turf)

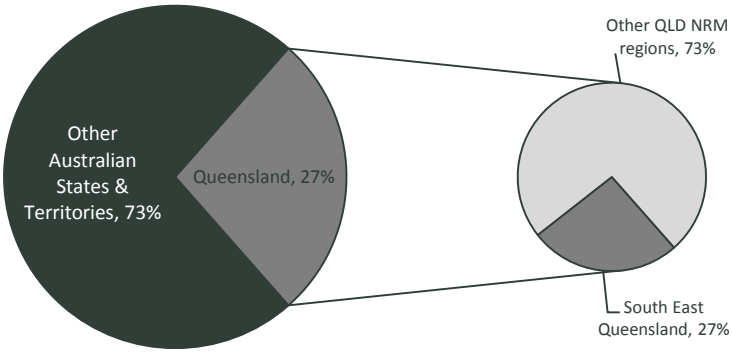

Figure 7: Place of Residence by Percentage of the Australian Horticultural Workforce (Fruit & Tree Nut Growing)

Figure 8: Place of Production by Percentage of Australia's Gross Value of Horticultural Commodities Produced (Fruit & Nuts)

What are the Potential Vulnerabilities?

The potential vulnerability of the horticulture sector was assessed using five factors known to shape socio-economic vulnerability:
a) percentage of the labour force employed in agriculture (Map 1);
b) geographic remoteness (Map 2);
c) socio-economic advantage/disadvantage (Map 3);
d) economic diversity (Map 4); and
e) age (Map 5). Each factor is considered one line of evidence. Areas in which multiple lines of evidence intersect suggest higher potential vulnerability than areas in which fewer lines intersect. Areas of potential high vulnerability are then compared to the areas that are characterised by high reliance upon the horticultural sector. Reliance upon the horticultural sector is indicated by: a) percentage of the gross value of horticultural commodities produced (Map 6); and b) percentage of the labour force employed in horticulture (Map 7).[3]

The areas within SEQ where multiple indicators of high potential vulnerability intersect were the north west (generally north of Crow's Nest), the south west (generally south of Gatton) and the area between Caboolture and Beerwah in the north east.

When compared to other parts of SEQ, these areas were all characterised by: a) high percentages of the labour force employed in agriculture (typically more than 20.1%, Map 1);
b) relatively high levels of socio-economic disadvantage (deciles 5-6 and lower, Map 3); and c) relatively specialised economies (Hachman Scores 0.60 and lower, Map 4). In addition, the far north west was the most remote part of SEQ, classified as 'outer regional', which suggests higher potential vulnerability than less remote parts of the region (Map 2).[5]

These three areas coincided with smaller, more localised areas which were characterised by high percentages of the labour force employed in the horticultural sector when compared to other parts of the region (Map 7).

1. Trending south west from Gatton to the boundary (the Lockyer valley), generally more than 10.1% of the labour force was employed in the horticultural sector; within this area, there was a small area in which more than 20.1% of the labour force was employed in horticulture.
2. Between Crow's Nest and Nanango, generally more than 10.1% of the labour force was employed in horticulture (almost entirely located with the area classified as 'inner regional').
3. Between Caboolture and Beerwah, generally more than 10.1% of the labour force was employed in horticulture.

In most cases, the percentage of the labour force employed in horticulture was generally less than the percentage of the labour force employed in agriculture, although the differential was less marked in the north east between Caboolture and Beerwah. This characteristic may reduce the potential vulnerability of these areas because it suggests that there are other agricultural employment opportunities should a downturn in the horticultural sector occur.

With regards to the percentage of the value of horticultural commodities produced (Map 6), the area immediately surrounding Gatton was the most important in the region. In 2010-11, this area, shown by the dark blue regions immediately east and west of Gatton, produced approximately 33% of the gross value of horticultural production from SEQ. In contrast, the north west and the area between Caboolture and Beerwah contributed much less to the gross value of horticultural commodities (4% and 20% respectively).

In the Lockyer Valley and the area surrounding Caboolture, approximately two-thirds of owner managers were aged 25-54 years (Lockyer Valley = 65%; Caboolture = 60%, Map 5). Owner managers in these age groups may have increased vulnerability because of potential adverse economic and social impacts arising from their dual obligations to business (e.g., owning income producing property) and family (e.g., dependent children) (Clemens et al., 2013).

In addition, these two subregions have the highest employee workforces in absolute numbers (Lockyer Valley n = 826; Caboolture n = 867), as well as high percentages of employees aged 15-44 years (Lockyer Valley = 65%; Caboolture = 67%). Thus, a downturn in the horticultural sector may impact a higher number of people in these areas than in the other parts of the region, and research has shown that younger people may disproportionately experience income loss during weather-related disasters when compared to older people (Clemens et al., 2013).

In both subregions, more than one-third of owner managers were aged 55 years or older (Lockyer Valley = 35%; Caboolture = 40%). While this age cohort may not have the same vulnerabilities as younger cohorts, they may have increased vulnerability in other areas. For example, older people have increased physical sensitivity to climate changes (e.g., increased temperatures) (Vaneckova et al., 2008).

Table 1 below summarises the individual influence of each factor upon the potential vulnerability of the SEQ horticultural sector. It shows each of the variables assessed with respect to their having limited or substantial influence upon the potential vulnerability of the sector.

Table 1: Summary of the influence of each factor upon the potential vulnerability of the South East Queensland horticultural sector

	Influence upon the potential vulnerability of the horticultural sector
Percentage of the Labour Force Employed in Agriculture (Map 1)	Limited influence: Although the two subregions characterised by the highest percentages of the labour force employed in horticulture and the highest percentages of the value of horticultural commodities produced (i.e., Lockyer Valley and the area between Caboolture and Beerwah) corresponded with areas in which high percentages of the labour force were employed in agriculture (suggesting high potential vulnerability), lower percentages of the labour force were employed in horticulture. This suggests that there may be other agricultural employment opportunities in these areas, increasing people's capacity to adapt to a downturn in the horticultural sector.
Geographic Remoteness (Map 2)	Limited influence: The two subregions characterised by the highest percentages of the labour force employed in horticulture and the highest percentages of the value of horticultural commodities produced were in areas classified as 'inner regional' or 'major cities', suggesting that there is good access to services and people living in these areas are likely to be less affected by weather/climate related disasters or events (Clemens et al., 2013).
Socio-economic Advantage & Disadvantage (Map 3)	Substantial influence: The two subregions characterised by the highest percentages of the labour force employed in horticulture and the highest percentages of the value of horticultural commodities produced corresponded with areas of higher socio-economic disadvantage when compared to other parts of SEQ, suggesting that people living in these areas may have reduced adaptive capacity (Sano et al., 2011; Clemens et al., 2013).
Economic Diversity (Map 4)	Substantial influence: The two subregions characterised by the highest percentages of the labour force employed in horticulture and the highest percentages of the value of horticultural commodities produced corresponded with areas that had less diverse local economies than other parts of the region, suggesting higher potential vulnerability to downturns in the horticultural sector because job opportunities are likely to be more specialised and may be more limited (Alston & Witney-Soanes, 2008).
Age (Map 5)	Substantial influence: The two subregions characterised by the highest percentages of the labour force employed in horticulture and the highest percentages of the value of horticultural commodities produced comprised workforces with high percentages of owner managers aged 25-54 years (Lockyer Valley = 65% and Caboolture = 60%). Owner managers in these age groups may be more vulnerable because of the potential for damage to income producing property combined with their responsibility for dependent family members (Clemens et al., 2013). In addition, more than two-thirds of employees were in the three youngest age groups, meaning the horticultural workforce in these areas have large subpopulations that tend to be disproportionately affected by income loss during weather-related disasters when compared to older people (Clemens et al., 2013).

Vulnerability Assessment

The horticultural sectors located in the Lockyer Valley and the area between Caboolture and Beerwah are characterised by the highest levels of potential vulnerability to the impacts of climate change in the SEQ NRM region. In the context of the wider region, these areas are the most socially and economically reliant upon the horticultural sector (i.e., they have high percentages of the labour force employed in horticulture and high percentages of the value of horticultural commodities produced, Maps 6 & 7).

When combined, the indicators used to assess vulnerability reveal that these areas correspond to parts of SEQ in which multiple lines of evidence for potential vulnerability intersect. Specifically, the Lockyer Valley and the area surrounding Caboolture have high levels of socio-economic disadvantage (Map 3), less diverse local economies (Map 4) and workforce age profiles which show high proportions of subpopulations that may be more vulnerable (i.e., younger employees and middle-aged owner managers).

Although the horticultural sector is dispersed more widely throughout SEQ, most other areas are potentially less vulnerable because they are characterised by lower percentages of the labour force employed in horticulture, lower percentages of the value of horticultural commodities produced and they generally have lower levels of socio-economic disadvantage (Map 3), as well as, more diverse local economies (Map 4). The most obvious exception is the area in the north west immediately north of Crow's Nest where there is also a high percentage of the labour force employed in horticulture. In this subregion, there were high levels of socio-economic disadvantage, and the economy was specialised. However, unlike the Lockyer Valley

and the Caboolture areas, the horticultural sector in the north west contributed minimally to the value of horticultural commodities produced; thus, has not been included in the above discussion.

What May Change?

Recognising that adaptations to climate change will be carried out in the context of other social, environmental and economic influences on the sustainability of the horticultural sector, it is useful to consider some key trends in more detail. CSIRO reports that 'megatrends', comprising the interaction between many trends, represent major shifts in "environmental, social and economic conditions that will substantially change the way people live" (Hajkowicz et al., 2012, p. 4).

CSIRO identify six megatrends that will influence contemporary decision-making and shape the future of Australia:

1. The 'More from Less' megatrend considers the limits to natural resources and how quality of life for current and future generations will be facilitated by companies, governments and communities.
2. The 'Going, Going… Gone?' megatrend considers the implications of declining ecological habitats and biodiversity due, in part, to climate change.
3. 'The Silk Highway' megatrend considers how the world economy will shift from west to east and north to south, changing export markets, trade ties and business models.
4. The 'Forever Young' megatrend focuses upon the advantages and the challenges posed by Australia's ageing population.
5. The 'Virtually Here' megatrend considers the implications of increased connectivity of individuals, communities and governments through virtual platforms.
6. The 'Great Expectations' megatrend considers the implications of increasing demand—particularly in relation to demand for experiences over products – and the importance of social relationships in financially wealthy segments of society. At the same time, people in impoverished parts of the world will have expectations for basic necessities.

In this section, we consider the implications for the agricultural sector in light of CSIRO's megatrends alongside the indicators of socio-economic vulnerability. The associations and conclusions made below are not meant to be definitive; rather they are intended to demonstrate an approach to deliberating the potential implications of trends and system drivers that might not otherwise be traditionally applied to regional NRM practice.

Percentage of the Labour Force Employed in Agriculture

The impact of the six megatrends upon the percentage of the labour force employed in agriculture will likely be complex and multifaceted. The composition of the agricultural workforce will likely change, even if the percentage of the labour force employed in the sector remains stable. These changes may be driven by the new/different skill sets required and the changing location of agricultural production due to wider changes in the sector (e.g., residential expansion, competing land uses, increased corporatisation of supply chains, and investment cycles).

An increase in the ageing but active population offers the sector new (and potentially flexible) labour markets, but may limit opportunities for younger people as increased numbers of older people intensify competition for employment. These dynamics may have flow-on effects for agricultural innovation. For example, an ageing but more active labour force may also limit the opportunities for new, entrepreneurial workers to enter the agricultural sector, thereby inhibiting new ideas and innovation (see Florida, 2002, for an analysis of 'The Creative Class').

As people's economic and social expectations increase, those who are able to leave the agricultural sector for higher paying employment may do so, potentially reducing skill levels among agricultural workers. At the same time, adoption of digital technologies (e.g., precision farming techniques), and continued automation of production processes and supply chains may reduce the need for labour. These same technologies, however, offer opportunities for increased productivity and cost efficiencies, increased collaboration across scales, and access to new but more distant markets.

The effects of these trends will be experienced differently between regions. Agricultural industries located in more urbanised regions (e.g., Hawkesbury-Nepean and South East Queensland) will likely have better access to more diverse labour markets than more regional or remote areas (e.g., Fitzroy and Northern Rivers).

Geographic Remoteness

A growing population and increased urbanisation may intensify the differentiation between metropolitan areas and regional/rural/remote areas. These trends may be more acutely experienced in Fitzroy, Burnett-Mary and areas in Northern Rivers where large areas are already classified as 'outer regional or 'Remote'.

In addition, increased levels of foreign investment will likely concentrate in particular areas where prevailing conditions are more conducive to investment needs – meaning that other areas will be bypassed – potentially exacerbating existing disadvantage (Pritchard & Tonts, 2011). The implication for NRM managers is that they may need to consider the likely cycles of foreign investment, the differential impacts these cycles

will have within and between regions, and the potential implications for changes in land use.

Akin to urbanisation trends, these changes will also potentially intensify the differential between regions in different remoteness categories. Any adverse effects may be mediated by increased access to digital technologies in the regions providing agricultural businesses with better access to information, markets and professional networks (e.g., national broadband network).

Altered growing conditions shaped by climatic changes (e.g., increased temperatures, increased evapotranspiration, and reduced soil moisture),[6] may force or allow for crop and/or farm system changes. In turn, there may be positive, but spatially differentiated, consequences for agricultural production and the economic value generated, potentially making some remote, marginal agricultural areas less marginal. However, any advantages may be counteracted by increased water scarcity which will likely drive changes in growing seasons and farm systems.

An ageing population is a marked feature of many rural and regional areas, but there are different dynamics with regards to the key drivers (e.g., people ageing in place, high in-migration of older people or high out-migration of young people) (Regional Australia Institute, 2014). The implication for NRM managers is to recognise the likely continued ageing of many regional/rural areas and the associated implications for the agricultural labour force, as well as agricultural support services.

Socio-economic Advantage/Disadvantage

The megatrends will likely increase the overall wealth of a population, but its distribution will likely be uneven, intensifying current socio-economic inequalities. The differentiation between advantaged populations and disadvantaged populations may be exacerbated by increasing energy costs and food prices. The challenges experienced by socio-economically disadvantaged cohorts may be further intensified by increased wealth and demand originating in Asia, with flow-on impacts to higher living costs.

The potential limitations to increasing economic diversity arising from resource scarcity (in particular water) may increase socio-economic disadvantage of marginal agricultural areas. Despite there being increased opportunities for innovation and use of digital technologies, higher levels of socio-economic disadvantage may continue to limit the capacity of some population groups to reap the benefits. Socio-economic disadvantage may also be exacerbated in some areas where retirees have limited financial resources. These adverse impacts may be off-set by older people being more active and, therefore, able to stay in the workforce for longer. These trends may simply displace socio-economic disadvantage to younger people who may be unable to find employment.

Economic Diversity

Diverse economies are often less vulnerable than economies characterised by lower levels of economic diversity (Alston & Witney-Soanes, 2008). It is unclear how the megatrends may affect wider economic diversity at the local scale; however, the potential implications for diversity within the agricultural sector are clearer.

Population growth at domestic and global scales, combined with changing patterns of consumption, will potentially create pressure for agricultural businesses and regions to diversify their product base to satisfy consumer demands from emerging markets (e.g., South East Asia). However, increases to agricultural production and production efficiencies in emerging nations may increase competition for agricultural products in the global market. The success of Australian producers in this context will continue to be influenced by global trading rules and the agricultural policies of individual nations. Adverse consequences may be mitigated by: a) increased demand through the increasing population of middle classes in nations such as China and India; and b) increased demand for high value-added products linked to healthy lifestyles and rural experiences (e.g., agri-tourism).

The capacity of individual businesses and regions to capitalise on these opportunities may be hindered in light of increased resource scarcity (e.g., water), which may inflate the costs of production. The way in which these trends intersect will likely differ between places; in particular, diversification in already marginal agricultural areas may be especially difficult.

Innovation in business models and farm systems is likely to be a critical influence upon economic diversity. New digital technologies offer scope for innovation in supply chains, collaboration, access to knowledge and marketing. However, longer life spans combined with an ageing agricultural workforce may constrain workforce turnover, reducing the number of new entrants with new knowledge and skills and, subsequently, impede sector innovation (see above).

Age

The implications of the megatrends for the age profiles of the agricultural sector will not be linear. In general, longer lifespans and an ageing population, combined with social expectations related to higher living standards (e.g., services and experiences), will likely result in an older agricultural workforce as people seek to maintain income levels beyond the official retirement age. These dynamics may entrench further aged workforces in some agricultural sectors.

At the same time, it is well established that older people tend to be more vulnerable to temperature extremes (Vaneckova et al., 2008). Thus, increases in

extreme climate-related events may reduce older people's capacity to participate in the labour force. These potential adverse effects upon the agricultural workforce may be counteracted by older people who are more active. In the short- to medium-term, an ageing agricultural workforce may have reduced capacity with which to deploy and use digital technologies that may provide diversification benefits, improve business management and enhance productivity.

More extreme climate-related events may also heighten adverse impacts for owners of income producing property who also have dependent family members (Clemens et al., 2013).

In Table 2 below we highlight the aspects of CSIRO's megatrends that seem most relevant to the potential vulnerability of the SEQ horticultural sector.

Table 2: Possible implications of the megatrends for the South East Queensland horticultural sector

	Implications of the megatrends
Percentage of the Labour Force Employed in Agriculture (Map 1)	The close proximity of the Lockyer Valley and Caboolture to Brisbane makes both subregions susceptible to sustained urbanisation pressures, particularly with regards to competition for land. These dynamics may create an agricultural sector that is more dependent upon horticulture as a result of a decline in more extensive agricultural industries that currently operate alongside horticulture. In the Lockyer Valley, the agricultural sector that employed the second highest percentage of the labour force was Sheep, Beef Cattle and Grain Farming. In the area between Caboolture and Beerwah, Sheep, Beef Cattle and Grain farming currently co-exists with horticulture only in the north west of the subregion (i.e., around Woodford). In sum, the megatrends may reduce the differential between the percentage of the labour force in agriculture and the percentage of the labour force in horticulture. The outcome of these processes may exacerbate socio-economic vulnerability to the impacts of climate change because in the future there may be fewer alternative agricultural employment opportunities if there is a downturn in the horticultural sector.
Geographic Remoteness (Map 2)	The close proximity of the Lockyer Valley and Caboolture horticultural sectors to Brisbane suggests that they will continue to benefit from good access to large labour markets, services and infrastructure, as well as supply chains and consumers. Conversely, these advantages may be counteracted by increased urbanisation and development leading to increased competition for resources and costs of production (e.g., energy, water). In the case of the Lockyer Valley, it is suitably located near tertiary education facilities that have agricultural offerings (Gatton & Toowoomba) which may be used to address workforce skill shortages and/or increase innovation in the sector.
Socio-economic Advantage & Disadvantage (Map 3)	Despite the proximity of the Lockyer Valley and Caboolture areas to services, the dominant influence of the megatrends upon socio-economic advantage/disadvantage may be one of entrenching existing inequalities. That is, the potential vulnerability of these horticultural sectors may increase as they are already located in areas of high socio-economic disadvantage. Thus, on the one hand, the horticultural sector may benefit from increased consumer demand and wealth, but on the other, its workforce may be negatively impacted by associated increases in energy and food costs imposed by increased demand and resource scarcity.
Economic Diversity (Map 4)	The Lockyer Valley and Caboolture horticultural sectors are ideally situated close to services to capitalise on emerging domestic and international markets. Proximity to, and potential innovation in the ways that producers interact with supply chains, offer opportunities for diversification in horticultural products to meet demand for higher value added products among the increasing middle class in Asia, as well as diversification into products associated with the burgeoning health industry in Australia. These opportunities, however, may be difficult to capitalise upon because of increased resource scarcity, in particular water.
Age (Map 5)	Although the population living in and surrounding Brisbane is characterised by an average rate of ageing when compared to other parts of Australia (Regional Australia Institute, 2014), the proximity of the Lockyer Valley and Caboolture areas to a large metropolitan areas suggests that these horticultural sectors may become more reliant upon older workers as younger people pursue easily accessible training and higher paying employment opportunities. These dynamics may create the circumstances for low workforce turnover and flow-on challenges for innovation as discussed above.

Endnotes

[1] Using resource dependency as a proxy for sensitivity to climate change impacts follows recent Australian work (see Marshall et al., 2014; Marshall et al., 2013).
[2] Smith, E., Keys, N., Lieske, S., & Smith, T. (2014a). South East Queensland Natural Resource Management Region: Horticultural Sector, prepared as part of the East Coast NRM Cluster, University of the Sunshine Coast, Sippy Downs, Queensland, Australia.
[3] An earlier report describes in detail the methods used to compile the data from which the maps are derived (Smith et al., 2014b).
[4] The sub-sectors were derived from the Australian Bureau of Statistics' classifications used to report data from the 'Census of Population and Housing 2011' and the 'Agricultural Census 2010-11' (see Smith et al., 2014b).
[5] The same claim can be made about the Stradbroke and Moreton Bay Islands off the east coast. However, there is no agricultural activity on the islands (Maps 1, 6, 7). Given the agricultural focus of this assessment, interpretations are made accordingly.
[6] See The East Coast Cluster Climate Projections report for a comprehensive assessment of anticipated climatic changes in the region.

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Further Information

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This commentary forms part of the activities of the Climate Change Adaptation for Natural Resource Management in East Coast Australia project. It is the fourth and final product from the socio-economic vulnerability component of the project. The three other products from the socio-economic vulnerability component are:

1. Six sector-based Fact Sheets (one for each NRM region in the East Coast Cluster)
2. An interim Report (Smith, Lieske, Keys & Smith, 2014b)
3. Six sets of maps (one for each NRM region in the East Coast Cluster)

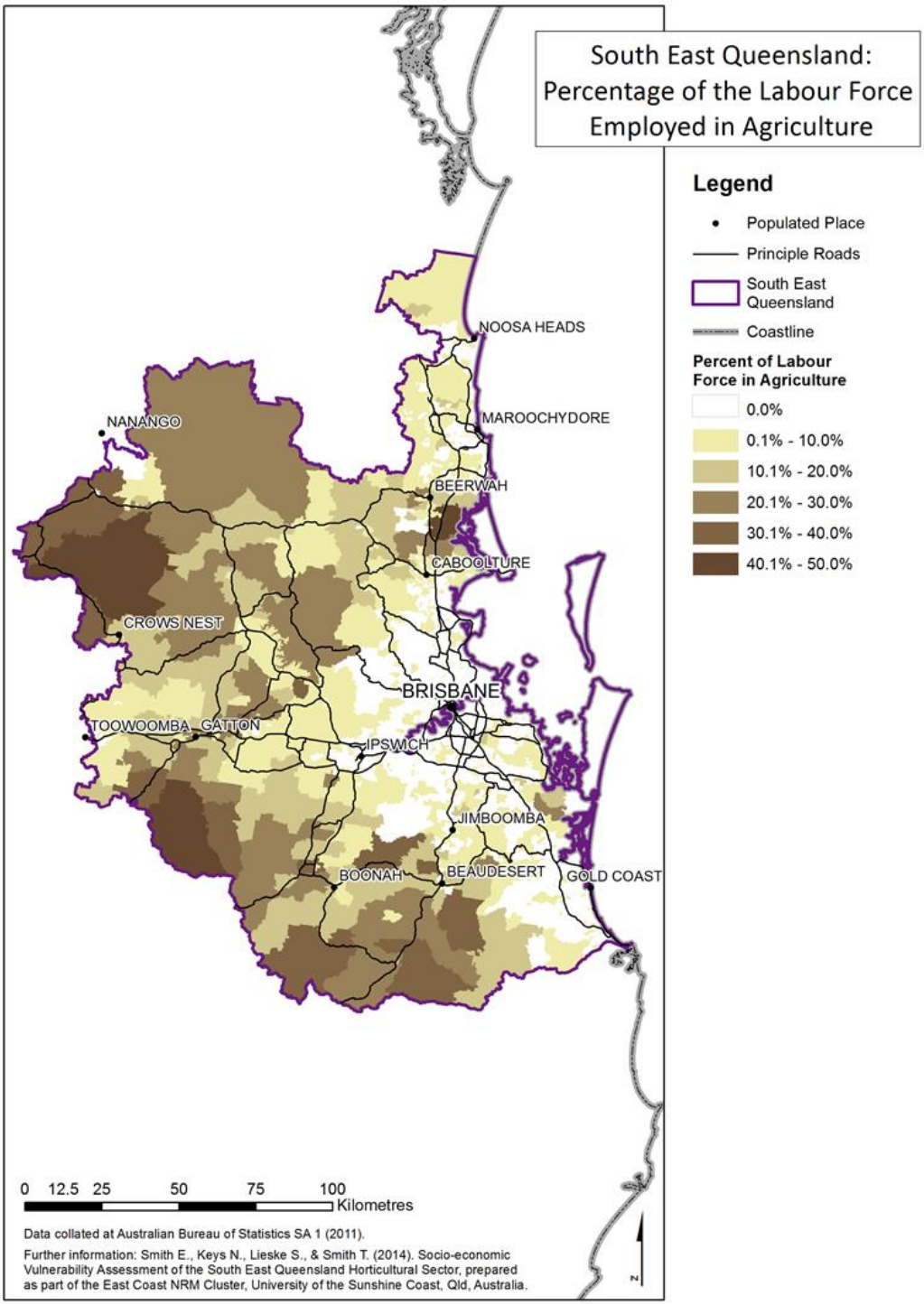
The Climate Change Adaptation for Natural Resource Management in East Coast Australia project aims to foster and support an effective "community of practice" for climate adaptation within the East Coast Cluster regions that will increase the capacity for adaptation to climate and ocean change through enhancements in knowledge and skills and through the establishment of long term collaborations. The East Coast Cluster consists of the coastal Natural Resource Management (NRM) bodies in Queensland and New South Wales between Rockhampton and Sydney. The Research Consortium comprises: University of Queensland (Consortium leader); Griffith University; University of Sunshine Coast; CSIRO; University of Wollongong; New South Wales Office of Environment and Heritage; and Queensland Department of Science, IT, Innovation and the Arts (Queensland Herbarium). The views expressed herein are not necessarily the views of the consortium partners, and the consortium partners do not accept responsibility for any information or advice contained herein. The East Coast NRM Cluster received funding from the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education as part of the Natural Resource Management Climate Change Impacts and Adaptation Research Grants Program, under the Natural Resource Management Planning for Climate Change Fund - A Clean Energy Future Initiative. The views expressed herein are not necessarily the views of the Commonwealth of Australia, and the Commonwealth does not accept responsibility for any information or advice contained herein.

Contact information:

Professor Tim Smith
+61 (0) 7 5459 4891
tsmith5@usc.edu.au
www.usc.edu.au

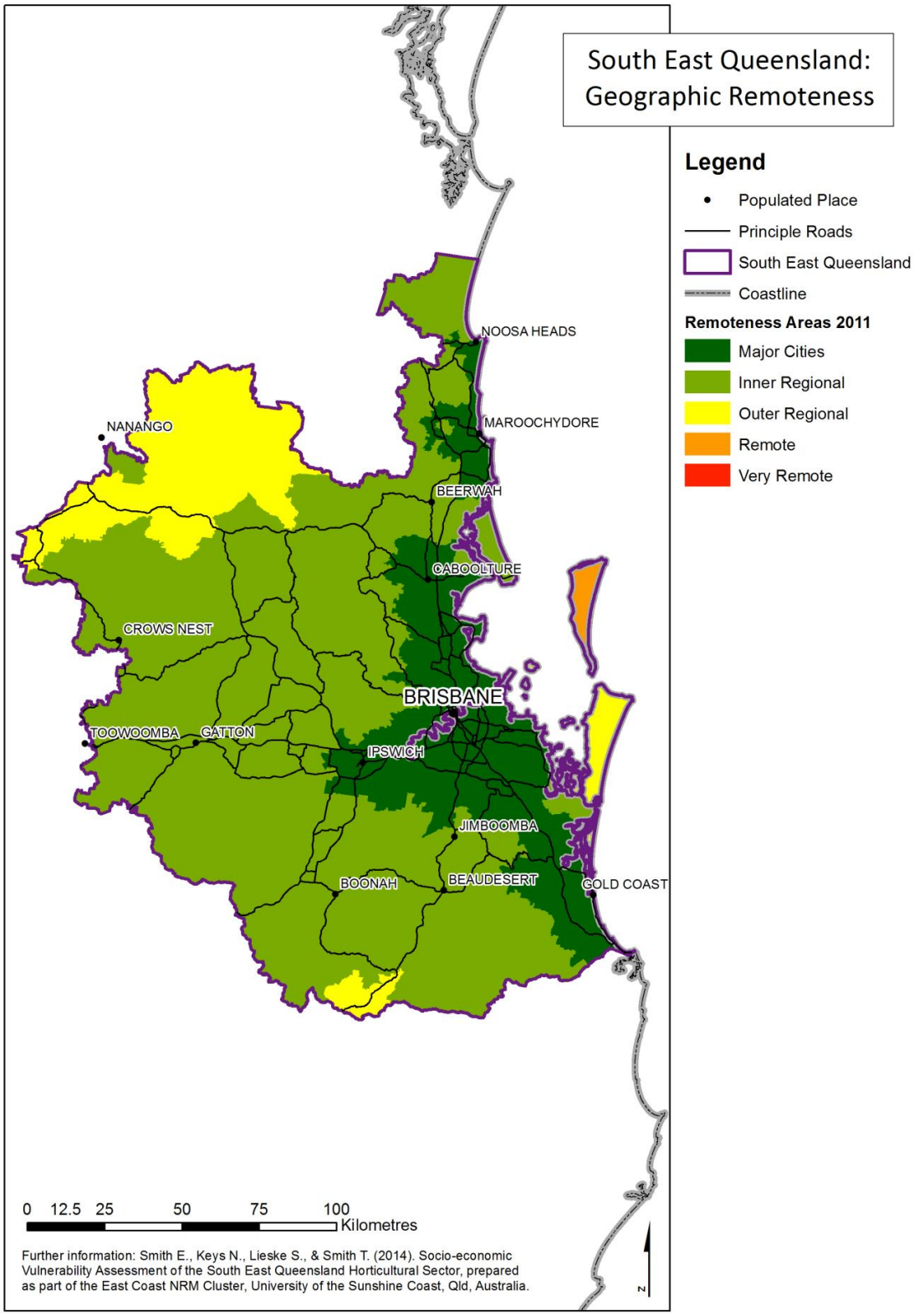
Map 1: Percentage of the Labour Force Employed in Agriculture

Why consider the percentage of the labour force employed in agriculture? Sensitivity to the impacts of climate change has been associated with the degree to which a population is dependent upon natural resources (Marshall et al., 2013; Marshall et al., 2014). Populations dependent upon economic sectors that are characterised as being highly resource dependent may be highly sensitive to climatic variability. Agriculture, broadly defined, is highly dependent upon natural resources; thus, populations in which a high percentage of the labour force is employed in agriculture may be more vulnerable to downturns in one or more agricultural sectors. Assessing the percentage of the labour force employed in agriculture enables comparisons to the percentage of the labour force employed in individual agricultural sectors (e.g., horticulture, grazing) and, therefore, provides an indication of the diversity of the agricultural sector.



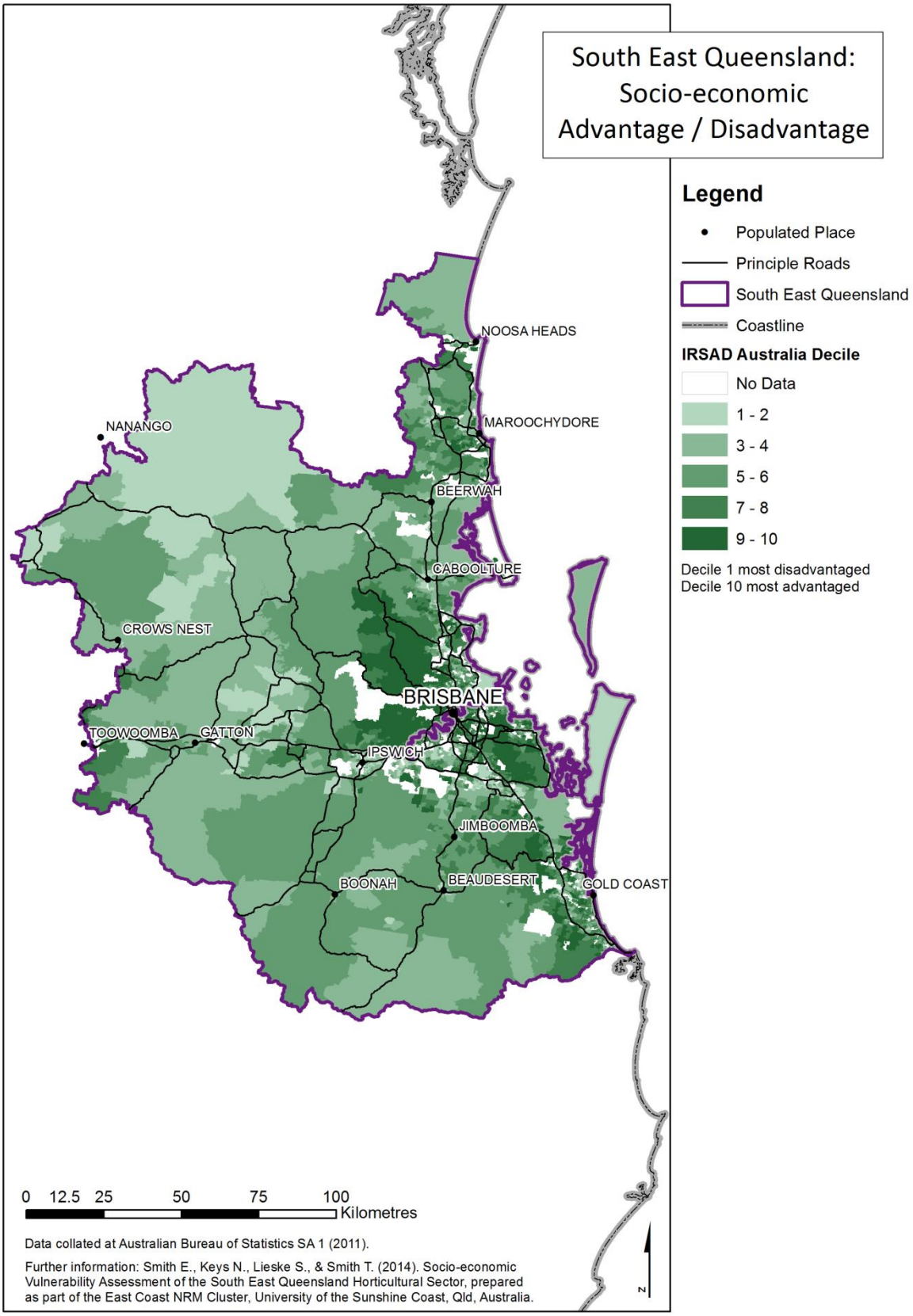
Map 2: Geographic Remoteness

Why consider geographic remoteness? Rural and regional areas are often characterised by higher levels of disadvantage than urban areas because of the interaction between socio-economic characteristics of the population and the characteristics of particular places (Gray & Lawrence, 2001; Barclay, 2014). After the natural disasters in Queensland in 2010-11, researchers found that higher proportions of people living in rural and remote areas reported suffering adverse impacts when compared to people living in larger urban areas (Clemens, et al., 2013).



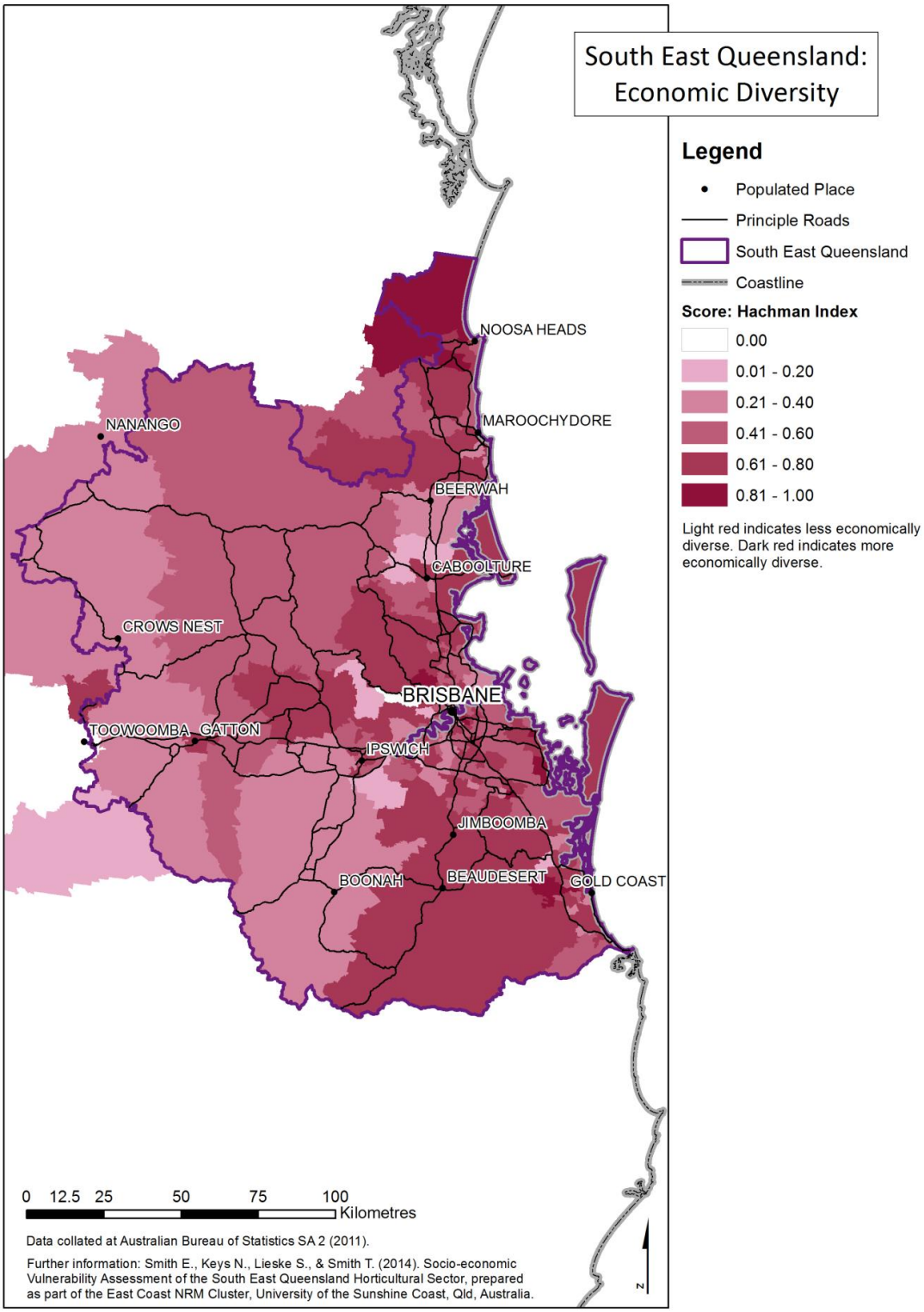
Map 3: Socio-economic Advantage / Disadvantage

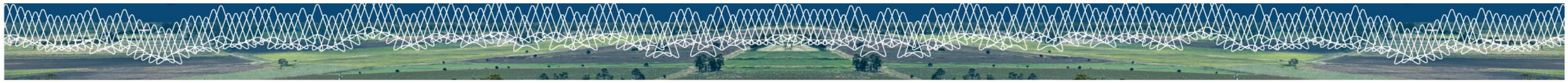
Populations with higher levels of socio-economic disadvantage may have increased sensitivity (and reduced adaptive capacity) to the impacts of climatic and environmental changes. For example, in a study of the impacts of trauma after Queensland's floods in 2010-11, Clemens et al., (2013) reported that people in socio-economically disadvantaged areas were disproportionately likely to report exposure to property damage and emotional impacts when compared to more advantaged subpopulations.



Map 4: Economic Diversity

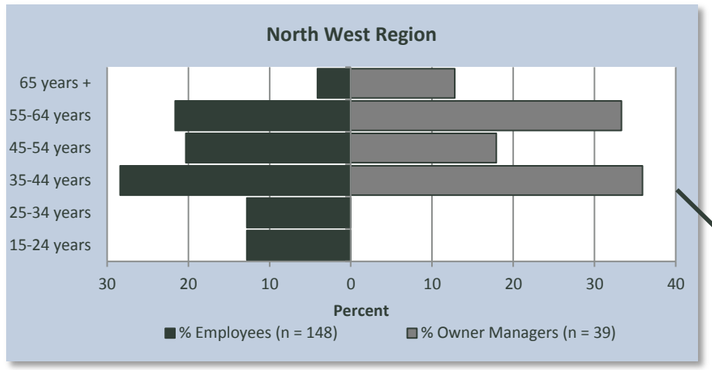
Why consider economic diversity? A diverse economy may contribute toward reduced socio-economic vulnerability because it provides a broader range of employment opportunities if individual sectors experience a downturn due to economic or environmental factors. Researchers found that farming and small communities in the Murray-Darling Basin tended to experience more acutely negative social impacts of drought if they were almost totally reliant upon agricultural sectors, with almost no alternative avenues of employment (Alston & Witney-Soanes, 2008). The Hachman Index is a measure of how closely the employment distribution of a region resembles the distribution of employment in a benchmark region. Hachman scores range from 0.00-1.00, where the economic diversity of the Australian economy is assumed to be equal to 1.00.

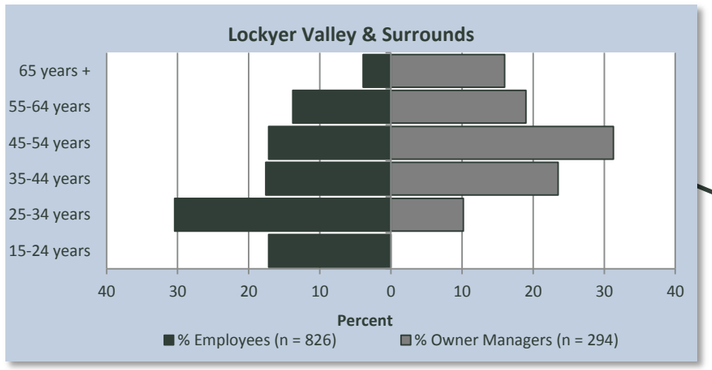


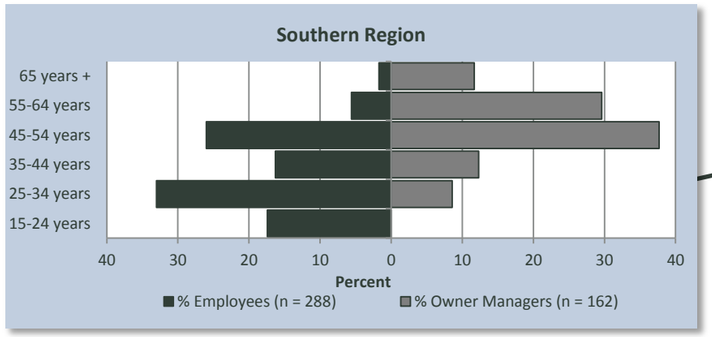


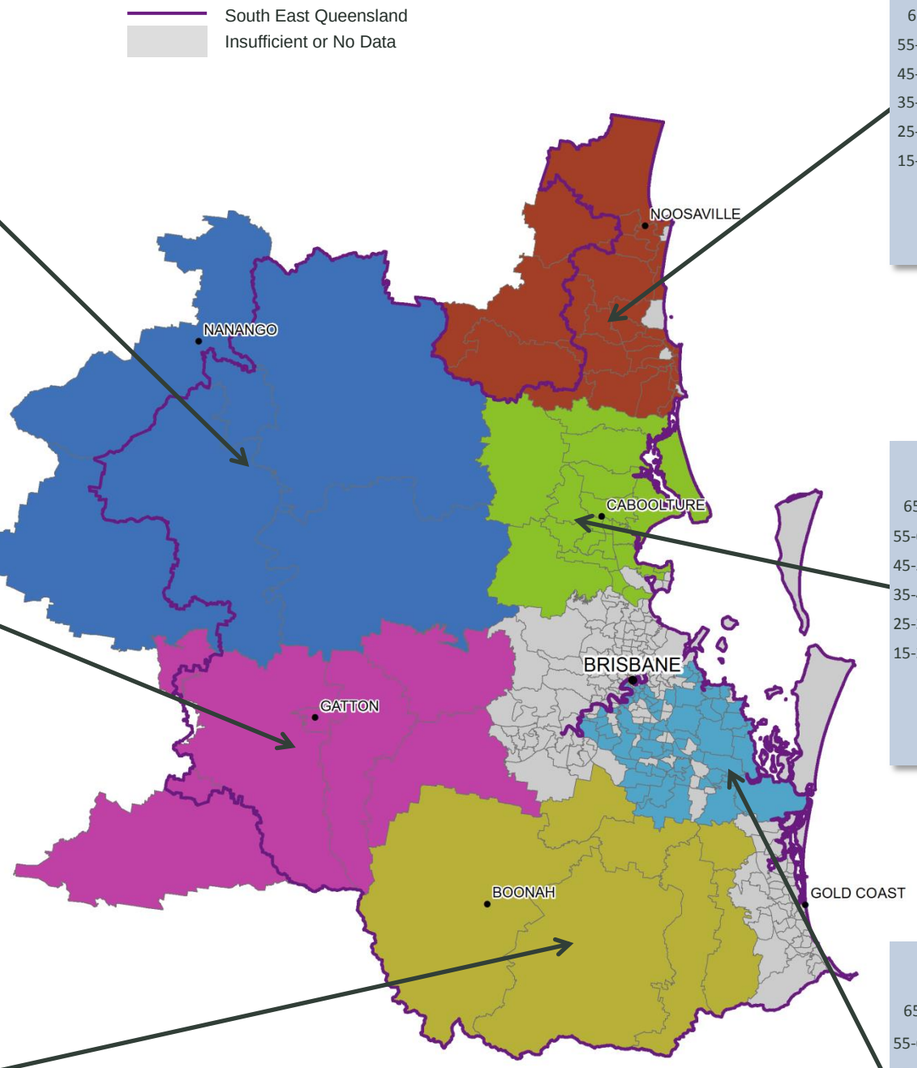
Map 5: South-East Queensland: Age Profiles of the Horticultural Workforce

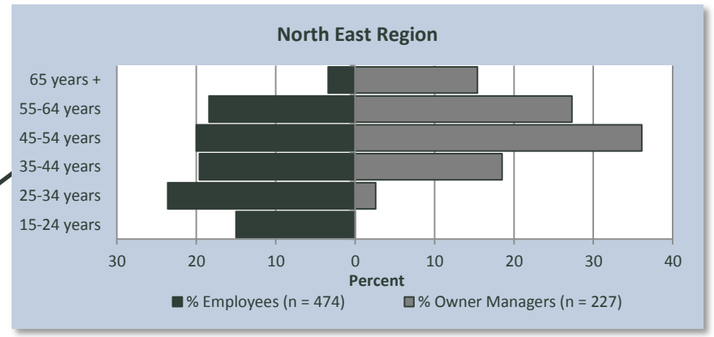
Why consider age? In general, older people may be more vulnerable to climate impacts than younger people because of their increased sensitivity to negative health impacts of climate changes (e.g., increased temperatures) (Vaneckova et al., 2008). Middle-aged owner managers may also be more vulnerable than employees because of reduced adaptive capacity arising from potential adverse climate-related impacts on their business property combined with potential adverse social impacts with their having dependent children (Clemens et al., 2013). For this reason, the age profiles of owner managers are separated from employees, as well as to capture differences/similarities in the age distribution of people who have decision-making responsibility when compared to the wider workforce.

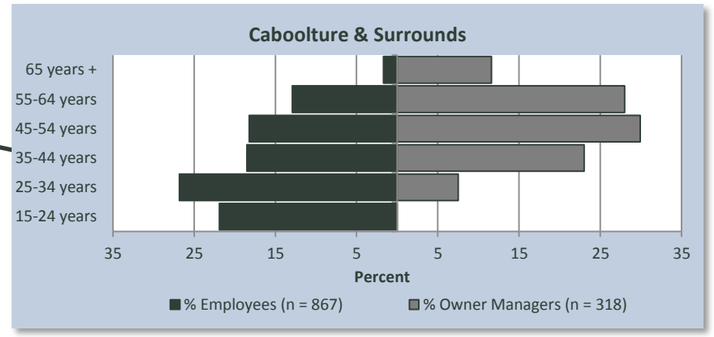


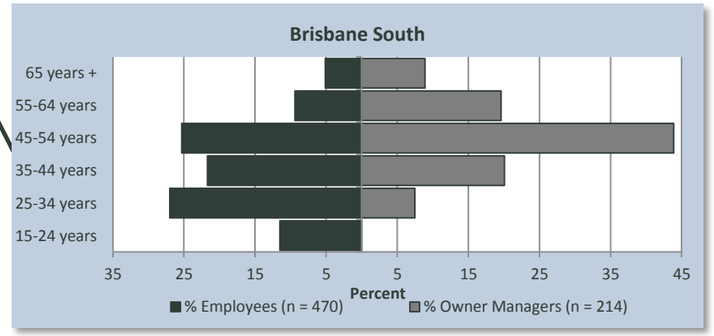




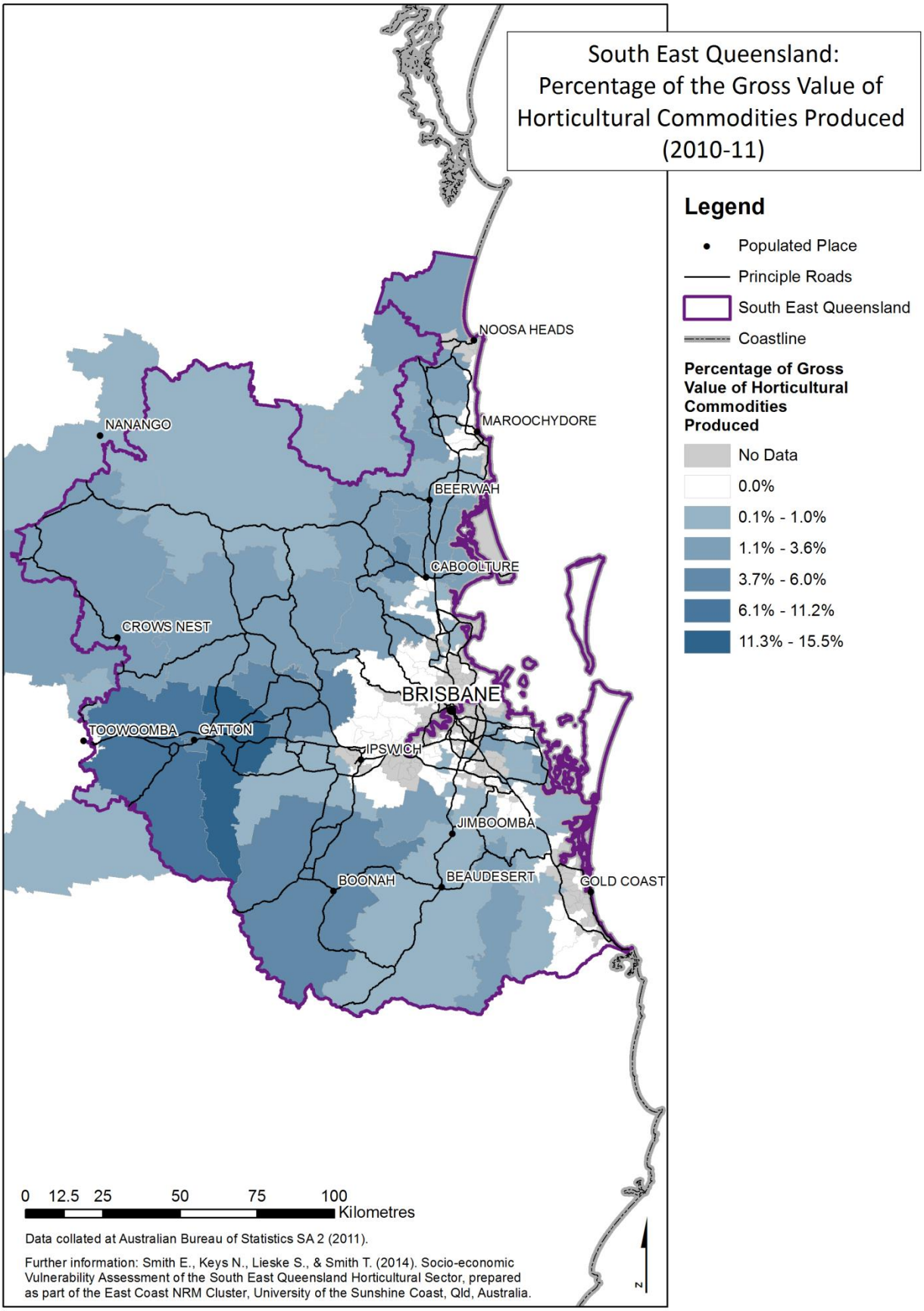








Map 6: Percentage of the Gross Value of Horticultural Commodities Produced (2010-11)



Map 7: Percentage of the Labour Force Employed in Horticulture (2011)