Garnaut Climate Change Review

Rural mental health impacts of climate change

Prepared by
Helen L Berry, Brian J Kelly, Ivan C Hanigan, Jamie H Coates, Anthony J McMichael, Jennifer A Welsh, Tord Kjellstrom
National Centre for Epidemiology and Population Health, ANU College of Medicine and Health Sciences

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1 Summary

This paper considers how climate change may affect rural Australian mental health. Rural Australians live with various systematic disadvantages and many feel marginalised; climate change, especially drought, has worsened this. With drier conditions and more severe droughts expected in much of southern and eastern Australia over coming decades, and the demands for change and adaptation that this will present, we urgently need to understand the likely consequences for the mental health and wellbeing of people in rural Australia. Existing knowledge can guide us through understanding likely mental health impacts of acute environmental events, such as natural disasters, but less is known about what chronic long-term environmental changes, such as drought, have brought in recent years. While we know how community and social factors affect mental health, and how best to help people cope with change or respond to health risks, we will need to apply such knowledge to this novel issue of climate change. In the expectation of more and generally worse adverse weather events, policy for rural mental health will need to (i) plan for consistent, long-term sustainability and adaptation, not reacting to each event as if it occurs in isolation, and (ii) be aware that social and economic factors—which climate change will affect—shape mental health.

We view our country as a land of climatic extremes. Rural Australian communities, where farming is the biggest industry, must deal with these extremes more than anyone else; their stories are well known to Australian social history. Rural communities are diverse and unique; some communities are very resilient. But, even in these, livelihoods are at stake. Farming is a stressful occupation (and faces the uncertainties of climate) at the best of times; drought and other changes that have affected many rural areas have driven many households from the land. The stresses of lost homes, lost income, debt and property damage inevitably spill over into mental health problems for some, and to the tragedy of despair and suicide for a few. Although many rural areas are familiar with drought and have adapted previously, drought in the context of longer term climate change is different and new for some—with the potential to alter hopes and expectations of recovery. As we come to understand the long-term effects of drought, we will have to learn about people's needs when they re-locate and even consider the possibility of drought refugees.

The exact burden of mental health problems is hard to quantify. Though, in recent years, mental health generally has received greater government and community attention, it has not received the formal research and documentation that it deserves—having long been neglected or seen as separate from, and less important than, physical health—and its individual manifestations are very diverse. However, for more than a decade, we have known from the World Health Organization that these problems will be the second leading cause of disease burden worldwide by 2020. In Australia, they already are. One in five Australian adults has a mental health problem each year, and the prevalence of these problems in children is increasing. Tragically, six Australians end their own lives each day, many of these young rural men (disproportionately Indigenous Australians in some states and territories). Beyond the personal, family and community anguish of climate-related mental health lies a very great economic cost via the losses of human capital, farm and related productivity and efficient community functioning. The stigma of mental health problems is also a major issue.

We do not have scope here to address Indigenous mental health separately, as it deserves. Besides, reliable data are hard to find. But we note the Indigenous concept of holistic health—the wellbeing of body, mind and spirit, grounded in connectedness to the land—which interprets the link between physical and mental health in a manner appropriate to Australian policy. Australian communities and environments are diverse and climate change will have a variety of emotional and social impacts. Some communities will need greater assistance to adapt, and the diversity of populations, distances, environments and current resources and services will mean innovation is needed in how such support and assistance is provided. Evidence-based and locally-attuned responses are required. Knowing that the weakest voices often go unheard, it is important to emphasise inclusion, with policies and services differentiated to suit the characteristics of recipients. Social capital—made up of community participation and social cohesion—is especially important for poorly connected people and for people with intransigent problems.

Recent state and national initiatives show that communities' mental health is a shared responsibility and a priority of all human service agencies and sectors. In rural communities, particularly, the best mental health outcomes are achieved when all relevant services work closely alongside health services, spanning community development, specific improvements in health service access, and more appropriate health care models. These services will also need to adapt and develop capacity to address emerging health effects of climate change. Community-service provider collaboration will be critical to achieving these goals and maintaining a focus on prevention, health promotion, early intervention and recovery programs. Recognising that mental health problems are so pervasive that clinical services cannot satisfactorily meet treatment needs, and that prevention is preferable to treatment, we advocate a dual preventative approach: adapting existing effective service models, using front-line agencies to integrate and sustain relevant services and ensure their continuity; and a prevention-focused public health approach to mental health that integrates health and (especially) social policy. Strategies that build individual, household and community strength, and that build on strength will be the most effective.

Essential future research requirements will include:

- describing exactly how climate change affects mental health
- better understanding resilience and vulnerability, and the role of social capital in both
- studying special groups, such as children and vulnerable adults
- learning how best to develop the mental health workforce, especially for primary health care
- including communities and stakeholders as partners in research, especially to learn how they understand climate change risk, what they perceive they need and which groups are at particular risk.

2 Introduction and aim of paper

2.1 Aim

The aim of this paper is to identify the potential impacts of climate change on rural Australian mental health.

2.2 Burden of disease

The World Health Organization (WHO) has, appropriately, defined mental health as part of a wider concept of health: 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity'(World Health Organization, 1998). We commend Helen Herrman's elegant Australian definition of mental health as people's ability to '… think and learn, ….and [to] live with their own emotions and the reactions of others' (Herrman, 2001:710). The proportion of people worldwide and in Australia enjoying good mental health has been decreasing steadily. A decade ago, the WHO's Global Burden of Disease project estimated that, by around 2020, depression would be the second leading cause of burden of disease, with other high prevalence psychiatric disorders also featuring in the top twenty diseases (Murray & Lopez, 1996). In America, the prevalence of common mental health problems, such as anxiety and depression in particular, has been increasing steadily since the 1950s (Twenge, 2000), with levels of depressive disorders considered likely to continue to grow (Sartorius, 2001). A decade later, psychiatric disorders have been estimated to comprise at least 14% of global disease burden (Prince, Patel, Saxena, Maj, Maselko, Phillips, & Rahman, 2007) and will likely constitute the second greatest burden of non-fatal disease by 2030 (Mathers & Loncar 2006).

Australia has not escaped this trend. Since prevalence figures have been estimated, mental health problems have been our leading cause of non-fatal disease burden, accounting for nearly one-third of years lost to disability (Mathers, Vos, & Stevenson, 1999). We have known for a decade that around one in five Australian adults meets the diagnostic criteria for a mental disorder each year, accounting for more than twice the level of disability or impairment than the next most disabling health problem, nervous system and sense organ disorders (Andrews, Hall, Teesson, & Henderson, 1999). This does not include the much larger proportion of Australians who experience milder but, nevertheless, distressing forms of common mental health problems. More recently, the Australian Institute of Health and Welfare burden of disease and injury in Australia report 2003 found that mental and neurological disorders, excluding dementia, accounted for 24% of the total health burden and that these disorders were the second largest contributors to disability-adjusted life years (DALYs) (Begg, Vos, Barker, Stevenson, Stanley, & Lopez, 2003). The prevalence of mental health problems has also been increasing among children in Australia (Langsford, Houghton, Douglas, & Whiting, 2001), as it has in America (Browne, Gafni, Roberts, Byrne, & Majumdar, 2004).

2.3 Mental health in rural Australia

In Australia, because of its geography and population dispersion, there is growing research and policy interest in the mental health of people living in rural and remote areas (Fuller, Edwards, Martinez, Edwards, & Reid, 2004; Habibis, Hazelton, Schneider, Davidson, & Bowling, 2003). Rural Australians experience very high levels of disadvantage(Alston, 2002), with substantial inequality of psychiatric service provision and use and difficultly and disproportionate expense in accessing these services (Eckert, Taylor, & Wilkinson, 2004; Iacono, Davis, Humphreys, & Chandler, 2003; Morley, Pirkis, Naccarella, Kohn, Blashki, & Burgess, 2007; Murray, Judd, Jackson, Fraser, Komiti, Hodgins, Pattison, Humphreys, & Robins, 2004; Young & Dobson, 2003). Many rural Australians feel socially and politically marginalised (Alston, 2002; Alston & Kent, 2004; Fragar & Page, 2002; Fraser, Judd, Jackson, Murray, Humphreys, & Hodgins, 2002; Stehlik, 2003; Stehlik, Gray, & Lawrence 1999); a continued drift away from primary industry as the principle driver of the Australian economy can be expected to exacerbate this.

2.4 Suicide

Tragically, six Australians end their own lives each day, many of these young men living in rural and remote locations. There is some primary empirical evidence linking drought and suicide: the suicide rate in New South Wales has been found to be related to interannual rainfall variations. A decrease in precipitation of about 300mm has been associated with an approximately eight percent increase in the long-term mean suicide rate (Nicholls, Butler, & Hanigan, 2006). However, there are very significant problems in obtaining accurate data on suicide, but best estimates suggest suicides account for about 1.6% of all cause mortality (Australian Bureau of Statistics, 2007). With around 80% of suicides occurring among men (Australian Bureau of Statistics, 2007), suicide and self-harm account for more than five percent of male fatal disease burden (Begg, Vos, Barker, Stevenson, Stanley, & Lopez, 2003). Among 20–34 year old men, suicide accounted for one-fifth of all cause mortality in 2005 (Australian Bureau of Statistics, 2007). Recent studies examining trends in Australian suicide rates have consistently demonstrated that male suicide rates are higher in rural and remote areas than they are in metropolitan areas; and consistently disproportionately elevated rates of suicide are found among Indigenous Australians in some states and territories (Australian Bureau of Statistics, 2007). At the same time, rates of suicide among very young men (20–24 years) halved between 1997–98 and 2003 from 40 to approximately 20 per 100,000, particularly those attributable to impulsive means (such as hanging) (Morrell, Page, & Taylor, 2007).

2.5 Climate change in rural Australia

Much of rural Australia (especially in the south, south-east and parts of eastern Australia) has experienced a severe and prolonged drought during 2001–2007. Economic, social and mental health stresses have resulted. Wellbeing and ways of living are under threat in some regions. Meanwhile, a longer-term drying process may now be under way. Such a trend, especially in the world's mid-latitude regions (approx 25–40 deg latitude), is thought likely as the world warms and rainfall systems are displaced towards the poles. The combination of reduced rainfall, increased rates of evaporation, and diminished stream/river flows mean that soil moisture and crop irrigation will both decline, with inevitable impairment of agricultural yields. Further, weather patterns are likely to become more variable, and include more extreme events (for a recent Australian review, see Bi & Parton, 2008). This situation casts a long shadow over the prospects for rural Australia.

2.6 Drought

Drought deserves particular mention with reference to climate change in rural Australia. Drying and warming, the latter of which will occur in all parts of Australia (Bi & Parton, 2008), will exacerbate the frequency and severity of droughts (and other weather events). Due to their location and reliance on agricultural industries, rural areas have always been more sensitive to climatic variation than have cities. Australian social history over the past two centuries is littered with accounts of farming regions that flourished and then declined, or of serious disruptions caused by major events, especially droughts and floods. But current circumstances are not simply a continuation of the normal situation. Australia's Bureau of Meteorology has concluded that the severity of the recent drought, 2001–2007, was, in part, due to the underlying warmer temperatures caused by climate change (Nicholls & Collins, 2006). This being the case, the hardships of rural lifestyles are likely to increase; livelihoods are at stake, and those who are most vulnerable, geographically or socioeconomically, are likely to be worst affected. The stresses of lost income, debt and damage to property inevitably spill over into mental health problems for some, and to the tragedy of despair and suicide for a few. The severity and distribution of these mental health problems are also influenced by aspects of community—resources, cohesion, resilience and external supports.

3 Issue definition

Though mental health may be seen at best as marginal as a health issue (Hickie, 2002), and less important than physical health (Thornton & Tuck, 2000), it must be understood that mental and physical health are deeply connected (Herrman, 2001). Where physical health problems are prevalent, so too will be mental health problems. To the extent that climate change impacts on mental health, it will impact on physical health, and vice versa. With service provision already under pressure in rural Australia, especially for mental health services, climate change is a serious risk for the development and course of health problems, particularly for mental health problems, among rural Australians. With their already very high and rising prevalence, and their substantial contribution to burden of disease, the potential impact of climate change on rates of mental health problems is a very significant risk factor for rural wellbeing, productivity and sustainability.

The link between acute weather disasters, such as floods and cyclones, and mental health problems is well-established, as are the emergency and other response procedures that are deployed when they occur. Less is known about the effects of chronic climate-related disasters, such as drought, on mental health—and the support services are less well-funded and less well-coordinated. It can be expected that the same loss of people, property and possessions, dislocation from community and disruption of key social connections that precede or amplify the development of psychiatric disorders following acute disasters would apply equally in response to chronic disasters of equivalent magnitude. The social and economic fabric of communities is, ultimately, no less affected by drought than it is by fires, floods or cyclones. In addition, given the chronic nature of drought, the very supports, services and community infrastructure that could mitigate the effects of drought on mental health may have been slowly eaten away by the time they are needed most. However, despite the plausibility of this expectation, there is little empirical evidence—almost none from large, well-controlled epidemiological studies—that shows which factors are in play or how they relate to mental health outcomes.

3.1 Risk and vulnerability

The likelihood of negative impacts of climate change on mental health will depend on the magnitude of the risk and the vulnerability of the community which will be affected. In considering potential mental health impacts of climate change in rural settings, we are thinking in terms of mitigation and adaptation; it is therefore essential to define risk and vulnerability in a pragmatic and policy-focused manner. Emergency Management Australia defines risk as the likelihood of harmful consequences arising from the interaction of hazards, communities and the environment, consistent with the Australian Standard 4360 definition of risk as the chance of an event occurring that will have an impact on objectives. The Emergency Management Australia definition of vulnerability is the degree of susceptibility and resilience of the community and environment to hazards. The International Decade for Natural Disaster Reduction definition of vulnerability is also used, given as the degree of loss to a given element at risk, or set of such elements, resulting from the occurrence of a phenomenon of a given magnitude. This is expressed on a scale of 0 (no damage) to 1 (total loss).

3.2 Indigenous Australians and relationship to place

It is well understood that the health status of Indigenous Australians is very substantially worse than that of other Australians. Northern Territory data indicate that the Indigenous burden of disease for 35–54 years is 4.1 times that of non-Indigenous Territorians (Ring & Brown, 2003). Nationally, 37% of indigenous Australians over 15 years have some kind of chronic disability. For an overview of the impact of climate change on Indigenous health generally, we refer the review team to our colleague, Donna Green's, paper *Climate Impacts on the Health of Remote Northern Australian Indigenous Communities.*

We do not have scope here to address Indigenous mental health separately, as it deserves. Data on the mental health of indigenous Australians are less reliable than are data for physical health (Hunter, 2007). But the AIHW *Australia's Health* report for 2006 reported that Indigenous Australians had twice the number of hospitalisations due to mental and behavioural disorders than did other Australians (Australian Institute for Health and Welfare, 2006), indicating substantially worse mental health,

consistent with physical health differentials. One issue we would like to highlight is the Indigenous concept of holistic health. As we have seen, mental health cannot be separated from physical health. Holistic health, the wellbeing of body, mind and spirit, grounded in connectedness to the land, takes this concept further and interprets it in an appropriate manner for Australia (for a review, see Burgess, Berry, Baillie, & Gunthorpe, under review).

While place is of particular significance to Indigenous Australians, it is important to everyone. Environmental relationships to health have often been narrowly articulated in terms of biophysical conditions (Horwitz, Lindsay, & O'Connor, 2001). But, more consistent with an Indigenous sense of wellbeing in a context of connectedness to country, there is a strong relationship between sense of place, the environment and human wellbeing, conceptualised via terms such as 'biophilia' (Gullone, 2000; Wilson, 1984) and 'solastalgia' (Connor, Albrecht, Higginbotham, Freeman, & Smith, 2004; Connor, Higginbotham, & Albrecht, 2001; Higginbotham, Connor, Albrecht, Freeman, & Agho, 2007). Biophilia describes the relationship between humans and their environmental conditions, while solastalgia describes the distress, the loss of solace, caused by degradation of the environment, home and sense of belonging.

3.3 Costs of mental health problems

The direct economic costs of mental health problems in most developed countries are enormous (Garattini, Barbui, Clemente, Cornago, & Parazzini, 2004; Ingoglia, 2003; Knapp, 2003), with depression and anxiety contributing the largest drain on healthcare resources (Tylee, 2000). Service costs alone accounted for $3 billion (6%) of Australia's total health care expenditure in 2001 (Australian Bureau of Statistics, 2005). In addition to direct service costs, mental health problems account for significant productivity losses among people in paid employment, particularly in terms of reduced effectiveness on the job, and also in terms of sick days (Lim, Sanderson, & Andrews, 2000). Job stress, including work overload, is associated with increased mental health problems (Strazdins, Shipley, & Broom, 2007) and more frequent and longer absences from work (D'Souza, Strazdins, Broom, Rodgers, & Berry, 2006). Farming is an inherently stressful occupation (Deary, Willcock, & McGregor, 1997; Firth, Williams, Herbison, & McGee, 2007; Fragar & Page, 2002; Fraser, Jackson, Judd, Komiti, Robins, Murray, Humphreys, Pattison, & Hodgins, 2005b; Fraser, Judd, Jackson, Murray, Humphreys, & Hodgins, 2002; Olson & Schellenberg, 1986), which is only made more difficult in times of drought and other extreme weather events.

For those with mental health problems, their subjective experience, and the accompanying levels of suffering, can be profoundly distressing. Western European research, which has attributed weightings to diseases that allow their relative severity to be compared, illustrates the severity of mental disorders. Among fifteen serious illnesses, severe depression ranked third in severity behind quadriplegia and being in the final year of a terminal illness (Schwarzinger, Stouthard, Burstrom, & Nord, 2003). The costs of psychiatric disorders are documented further afield, in areas as diverse as education, housing, welfare, and the criminal justice system (Ingoglia, 2003), the negative impacts of all of which further affect or are affected by mental health problems. Mental health problems place a great burden, financially and emotionally, on carers (Droes, Breebaart, Meiland, Van Tilburg, & Mellenbergh, 2004) and on others close to them. Children growing up in families in which one of their parents experiences mental health problems are at significantly higher risk than are other children of developing mental health problems or disordered behaviour (Baydar, Reid, & Webster-Stratton, 2003; Hinshaw, 2004; Kilic, Ozguven, & Sayil, 2003).

There are effective treatments available for mental health problems and a large body of scientific literature to support their effectiveness. Early treatment aids recovery in most instances. The greatest concern is that most people suffering from a mental health problem do not have access to these treatments, either because they lack knowledge or confidence about seeking help, or because of inequities in availability of services. The latter is particularly the case in rural regions (Australian Institute for Health and Welfare, 2006; Judd, Jackson, Davis, Cockram, Komiti, Allen, Murray, Kyrios, & Hodgins, 2001). It will be essential in designing policy responses to mental health risks associated with climate change to take into account the large body of knowledge about what works—in general, and in rural locations in particular.

4 Impacts of climate change

4.1 Indirect causal pathways

Climate change and weather events rarely, if ever, directly cause mental health problems. Instead, they cause other adversities (such as financial strain or loss of homes and businesses) which, like a domino effect, eventually contribute to mental health problems. Weather and weather events can contribute to causing many different adversities. Commonly, it is only after multiple adversities have built up that mental health problems develop. To further complicate the picture, different adversities affect people to different degrees and in different ways; sometimes, the very same adversities can lead to quite different, even opposite, outcomes. For the large majority of people, continuing adversity can be crushing, while, for a lucky few, it just makes them stronger. One way of making sense of this complexity is to highlight factors that will likely affect climate change-related population mental health *generally,* particularly with a view to what we know about mental health in rural and remote settings, and describe how their effects might play out.

4.2 Components of climate change that may affect mental health

Long-term underlying drying and associated increases in frequency, duration and intensity of drought, together with a projected increase in the frequency of extreme weather events, such as cyclones and floods, are well-documented components of climate change (Bi & Parton, 2008). In addition to too much or too little rain, rain may fall outside the periods in which it is needed for particular agricultural purposes, especially for cropping. Associated with changing patterns of precipitation, thermal stress from long periods of high temperatures, heat- and drought-related events (such as bushfires), and flood and related events (such as landslides), can be expected to increase. These will be accompanied by consequential environmental risk factors, such as smoke, pollen density, dust and plant disease and infestations. The quality and availability of water for human and livestock consumption may be compromised, with possible increases in water-borne disease.

Some environmental factors are already known to affect mood and mental health; if these (and, therefore, potentially other) environmental factors change for the worse, so, too, will mental health. Humidity levels have been associated with poorer concentration and elevated fatigue, and decreasing temperatures with increasing aggression (Howarth & Hoffman, 1984). Increasing temperatures (especially lengthy spells of hot weather) have also been associated with higher rates of criminal and aggressive behaviour (Brearley, 1929; Cheatwood, 1995; Cohn, Rotton, Peterson, & Tarr, 2004), higher suicide rates (Maes, De Meyer, Thompson, Peeters, & Cosyns, 1994) and increases in hospital admissions (Mastrangelo, Fedeli, Visentin, Milan, Fadda, & Spolaore, 2007). These apparently conflicting findings about temperature perhaps suggest an optimum temperature range, with temperatures that are either unusually cold or unusually hot associated with mental health problems. Global warming, with its associated increase in climatic extremes, may thus be expected to be associated with a general increase aggression (Anderson & Bushman, 1998), suicide and hospital admissions.

4.3 Temperature and humidity

Apart from the various clinical effects of heat associated with climate change, there are direct physiological effects of ‘heat strain’ that can reduce the ability work at full capacity and to carry out various daily activities. Australians are familiar with heat strain during days when the temperature soars above 35 or 40 degrees C. In combination with high humidity, such high heat exposure can be very debilitating. With temperatures expected to rise across an already hot country, and with physical health closely connected to mental health, mental health impacts may be expected from combined rises in temperature, changes to patterns of atmospheric moisture, and their associated disability. Guidelines for maximum recommended exposures exist for workplace exposures of this type (International Organization for Standardization, 1989). A heat index that combines temperature, humidity, solar radiation and wind influence on heat, called the wet bulb globe temperature (WBGT), has been developed for these guidelines (Australian Bureau of Meteorology, 2008). The guidelines indicate that, at a WBGT of 26 degrees C, the ability to work fully starts being impaired, particularly for heavy labouring jobs. At WBGT above 39 degrees C, even light work is affected. The consequences

of this for population health, defined broadly, can be very substantial in the type of climate conditions occurring in much of Australia during the warmer months (Kjellstrom, 2000).

Statistical associations between temperature and humidity with suicide and attempted suicide have been studied in a variety of populations; however, results have not been conclusive but have been somewhat contradictory. This is probably due to local and contextual differences in the determinants of suicidal behaviour and confounded by the use of different conceptualisations of exposure and statistical methods. In some studies, a negative association has been found with temperature (Geltzer, Geltzer, Dunford, & Hampson, 2000; Lester, 1999; Leung, Chung, & So, 2002; Marion, Agbayewa, & Wiggins, 1999; Partonen, Haukka, Pirkola, Isometsa, & Lonnqvist, 2004; Preti, 1998; Souetre, Wehr, Douillet, & Darcourt, 1990) while, in other studies, positive associations were observed (Barker, Hawton, Fagg, & Jennison, 1994; Breuer, Breuer, & Fischbachbreuer, 1986; Deisenhammer, Kemmler, & Parson, 2003; Deschenes & Moretti, 2007; Ganjavi, Schell, Cachon, & Porporino, 1985; Lester, 1986; Maes, De Meyer, Thompson, Peeters, & Cosyns, 1994; Marion, Agbayewa, & Wiggins, 1999; Page, Hajat, & Kovats, 2007; Partonen, Haukka, Pirkola, Isometsa, & Lonnqvist, 2004; Preti, 1997; Preti & Miotto, 1998; Souetre, Salvati, Belugou, Douillet, Braccini, & Darcourt, 1987; Yan, 2000). In one study, a U-shaped response function was seen (Wang, Wang, & Wang, 1997). In yet other studies, temperature was not associated with suicides (Chiu, 1988; Grove & Lynge, 1979; Linkowski, Martin, & Demaertelaer, 1992; Salib & Gray, 1997; Terao, Soeda, Yoshimura, Nakamura, & Iwata, 2002; Tietjen & Kripke, 1994; Zung & Green, 1974).

Findings for the relationship with humidity have also been inconsistent, with a positive association with suicide rates found in some studies (Breuer, Breuer, & Fischbachbreuer, 1986; Linkowski, Martin, & Demaertelaer, 1992; Salib & Gray, 1997), while negative associations have been observed in others (Deisenhammer, Kemmler, & Parson, 2003; Jessen, Jensen, & Steffensen, 1998; Maes, De Meyer, Thompson, Peeters, & Cosyns, 1994; Preti, 1997, 1998; Preti & Miotto, 1998). There have also been several studies that found no association (Chiu & Su, 2005; Ganjavi, Schell, Cachon, & Porporino, 1985; Salib & Gray, 1997; Zung & Green, 1974).

4.4 Mental health impacts of acute extreme events

Disasters, both human and natural, are associated with a range of psychiatric reactions from general somatic and mental health problems, followed by resilient recovery, to several types of enduring, severe psychopathology (for a review, see Norris, Friedman, Watson, Byrne, Diaz, & Kaniasty, 2002). Most research into the mental health impacts of weather events has concentrated on extreme, fast onset events such as earthquakes, floods and hurricanes, and associations with the onset of post-traumatic stress disorder (PTSD). Consistent with pathways models of mental health, PTSD is sensitive to a range of predisposing and exposure factors, with young people particularly vulnerable (Salcioglu, Basoglu, & Livanou, 2007). Natural disasters, including consequent loss of resources (Freedy, Saladin, Kilpatrick, Resnick, & Saunders, 1994), also cause substantial psychological distress (Beaudoin, 2007; Chandra, Pandav, Ofrin, Salunk, & Bhugra, 2006; Curtis, Mills, & Leitner, 2007; Freedy, Saladin, Kilpatrick, Resnick, & Saunders, 1994; McFarlane, Clayer, & Bookless, 1997; Rao, 2006; Raphael, 1986; Salcioglu, Basoglu, & Livanou, 2007).

4.5 Economic costs of slow-onset disasters

Slow onset disasters tend not to be associated with acute anxiety reactions such as PTSD, but more commonly with symptomatology related to chronic loss and failure, such as helplessness-induced depression, ongoing emotional distress and generalised anxiety (Coelho, Adair, & Mocellin, 2004). The dollar cost of the psychological impact of drought has recently been estimated as equivalent to an annual reduction in mean rural household income of A$18,000 (Carroll, Fritjers, & Shields, 2007). Increased workloads associated with climate-related business stress also indicate increased risk of mental health problems for parents (and, consequently, for their children Strazdins, Shipley, & Broom, 2007), and less time for friends, family and activities that strengthen social capital and mitigate psychiatric distress (Berry, Rodgers, & Dear, 2007). Periods of drought in rural areas over Spring (a significant time for agricultural production) are associated with a significant reduction in life satisfaction, estimated to cost the Australian economy $5.4 billion annually, with a projected ongoing reduction in GDP of 1% a year, should the frequency of drought continue as predicted (Carroll, Fritjers, & Shields, 2007).

4.6 Demographic impacts

Over the past thirty years, demographic and structural change has affected much of rural Australia (Fragar & Page, 2002; Fraser, Jackson, Judd, Komiti, Robins, Murray, Humphreys, Pattison, & Hodgins, 2005b), driven, in part, by global markets and an increased trend towards urbanisation. These authors note that, for some communities, particularly those in coastal settings, this has involved population growth and new service-based industries. However, inland areas dependent on volatile industries, such as agriculture and mining, have seen notable population decline. Due to agro-industrialisation (Burch & Rickson, 2001) and an emphasis on profitable farming (McMichael & Lawrence 2001), farming populations have declined, with the number of farming families decreasing by 22% since 1986 (Australian Bureau of Statistics, 2003). Farming, a major employer in rural Australia (Australian Bureau of Statistics, 1999), is highly sensitive to climatic variation, despite technological advances (Bi & Parton, 2008). The El Nino Southern Oscillation phenomenon, with its associated cycles of droughts and flooding events, explains between 15% and 35% of global yield variation in wheat, oilseeds, and coarse grains (Ferris, 1999). Through its impact on farming, in particular, drought has been a prominent driver of demographic changes (Fraser, Jackson, Judd, Komiti, Robins, Murray, Humphreys, Pattison, & Hodgins, 2005b). Rural-urban migration is likely to increase as climatic and economic conditions make parts of Australia inhospitable. This will be challenging for many rural Australians: net of other impacts of climate change (such as losing land, a home or a business), simply relocating, with its impact on sense of belonging, has been shown to be a significant source of distress and tension for both newcomers and the host community (Bhugra, 2004; Putnam, 2000, 2007).

4.7 Socioeconomic impacts

In the drought period from 2002 to 2003, GDP growth fell 1.0 percentage point, with gross value-added falling by 28.5% compared with the preceding year (Australian Bureau of Statistics, 2004). Not counting the costs of drought, including the most recent period of drought and extreme weather events, natural disasters cost Australia A$37.8b between 1967 and 1999. All but A$5b (earthquakes) was due to climate change (International Panel on Climate Change, 2007 in Bi, 2008 #2366). Falling agricultural production has placed pressure on downstream industries, such as transport and wholesale trade, small businesses and casual mobile labour, including shearers and farm hands. Reduced income for farming families and communities has many impacts. Family members are forced to move away from home for work, while additional pressures arise from financial support application processes. Women are particularly affected, being more likely than are men to migrate for employment or for their children's education (Alston & Kent, 2004; Stehlik, Lawrence, & Gray, 2000). Other impacts include fewer jobs for farm hands and less casual employment, resulting in population decline and increased workload for farmers. With the frequency and severity of drought predicted to increase, these impacts could be expected to continue and to increase in severity.

The relationship between socioeconomic hardship and poor mental health and functioning has long been demonstrated (Dohrenwend, 1990; Faris & Dunham, 1939; Hollingshead, 1958; Leighton, 1965; Srole, 1962). Climate change can be expected to place mounting pressure on this relationship. In long-term drought, objectively assessed deterioration in economic conditions over time has been associated with depression and demoralisation amongst parents (Conger, Conger, Elder, Lorenz, Simons, & Whitbeck, 1992). In addition, drought-prone areas may be associated with lower mean socioeconomic status and educational attainment, and consequently with higher levels of distress and learned helplessness, than are drought-free areas (Coelho, Adair, & Mocellin, 2004). Indeed, it has been proposed that socio-economic circumstances may be a more potent source of vulnerability to poor mental health than is the rural setting itself (Judd, Jackson, Komiti, Murray, Hodgins, & Fraser, 2002). Economic hardship is a particular concern among farming Australians, who are often asset rich and cash-flow poor, particularly during times of drought (Botterill, 2007). A favourable asset position can undermine eligibility for additional financial support during times of extreme cash-flow pressure.

4.8 Primary health care costs of climate change in rural locations

Providing mental health services in rural areas involves a huge financial cost in primary health care. In order to effectively deal with mental health problems created by climate change, there must be adaptive strategies (such as psychosocial support and disaster preparedness) put in place to curb its

detrimental effects (Blashki, McMichael, & Karoly, 2007). As Blashki (2008) notes, this represents a particular challenge because communities that are most vulnerable to climate change are generally underserviced rural and regional areas to begin with. Evidence is accruing that psychological interventions for depression (the most prevalent of common mental disorders) are at least as effective as antidepressants and superior to usual treatment (Moulding, Blashki, Gunn, Mihalopoulos, Pirkis, Naccarella, & Joubert, 2007). These interventions can be effectively delivered in primary health care settings; under the *Better Access to Psychiatrists, Psychologists and General Practitioners*, these services are delivered at little or no cost to clients (Morley, Pirkis, Naccarella, Kohn, Blashki, & Burgess, 2007).

Emphasising the development of adaptive strategies and cost-effective approaches to service provision will be a sensible and effective goal for supporting primary health care in Australia. Nevertheless, these strategies will represent a significant financial burden, at least initially. For example, the Mental Health Support for Drought Affected Communities initiative program, developed by the Department of Health and Ageing (DoHA), has received $10.9 million funding over two years (Department of Health and Ageing, 2007a). In addition, as part of the *Better Access to Psychiatrists, Psychologists and General Practitioners through the Medicare Benefits Schedule (MBS)* program, the Mental Health Services in Rural and Remote Areas program (also run through DoHA) has received $72.3 million dollars in funding over five years, $20.6 million of which has been specifically allocated for drought affected communities (Department of Health and Ageing, 2007b). Both of these initiatives are aimed at increasing primary health care services' capacity to provide mental health care to people living in rural and remote areas, and their ability to effectively deal with the psychological impacts of drought. Initial evidence suggests high uptake generally, and that these services—which are designed around service needs that are particularly applicable in rural settings—may be more acceptable in rural settings than they are in urban settings (Morley, Pirkis, Naccarella, Kohn, Blashki, & Burgess, 2007). All the same, they come at a cost.

5 Mental health impacts arising from gradual change in climate

[Scenarios provided by Review Secretariat]

Extreme climate change in Australia might result in drier *or* wetter conditions and will manifest in different ways in different regions—some of which might experience an improvement in climate-related conditions. The mental health impact of climate change will, consequently, vary across regions. Specific impacts will depend on existing climatic conditions in each region and on the particular manifestations of climate change in each region. These will interact with non-climate-related factors particular to each region, such as the industry mix and underlying socio-economic vulnerability. As climate change can be expected to have a greater impact on agriculture than on other industries, it will likely have the greatest impact—for better or for worse—in regions in which agriculture is a dominant industry. It may also be expected that the impacts might vary by type of agriculture. Thus, while agriculture overall will be sensitive to extreme impacts of climate change, specific impacts will depend, at least, on (i) current climatic conditions, (ii) how important agriculture is to the local industry base, (iii) what is being farmed and (iv) the underlying socio-economic vulnerability of the local area.

To illustrate the range of possible impacts of climate change in different regions of rural Australia, we modeled four hypothetical case studies. Our conceptual framework assumed that risk of adverse impact of climate change on mental health will be a combination of the likelihood of adverse climate change outcomes together with underlying socio-economic vulnerability moderated by the importance and nature of agriculture in the particular region. That is, adverse climate change will have a different impact on mental health in regions that are socio-economically vulnerable compared with those that are stronger; and on those where agriculture is an important part of the economic base relative to other industries in the region. We derived a two-by-two matrix in which the two primary dimensions of interest were: risk of extreme climate-change related impact on yield (high or low); and underlying socio-economic vulnerability of the region (high or low). We selected representative regions (statistical divisions) from around Australia for each cell of the matrix. We modeled agricultural yield (grazing *vs* wheat) for each of these for two reference scenarios (wet and dry) for dangerous climate change selected from those used in the Garnaut review for the higher CO_2 emission scenario (A1FI).

5.1 Methods

We selected the statistical divisions shown in Table 1 and Figure 1 from the Australian Bureau of Statistics census geographic system. The four statistical divisions we chose are outlined in bold font on Figure 1. These four regions typify the range of vulnerability and risk around Australia, taking account of the dimensions of interest and the supplementary factors: (i) regions where farming is important to the local economic base relative to other industries, (ii) regions from the Australian wheat belt and grazing lands and (iii) a substantial population base, such that a substantial proportion of the population would be included in the selected region and, therefore, a substantial absolute number of people reliant on agricultural incomes.

Table 1 Selected statistical divisions for four hypothetical case studies

	High risk	**Low Risk**
High Vulnerability	Midlands	Mackay
Low Vulnerability	Murrumbidgee	NSW Northern

5.2 Vulnerability

The underlying vulnerability of agricultural communities has been characterised by Nelson and colleagues (Nelson, Kokic, Elliston, & King, 2005) using farm survey data from across all regions of Australia to calculate a vulnerability index based on a 'five capitals' approach. The five capitals were: human capital (factors that influence the productivity of labour, such as skills, health and management capacity, including education); social capital (patterns of community participation and social

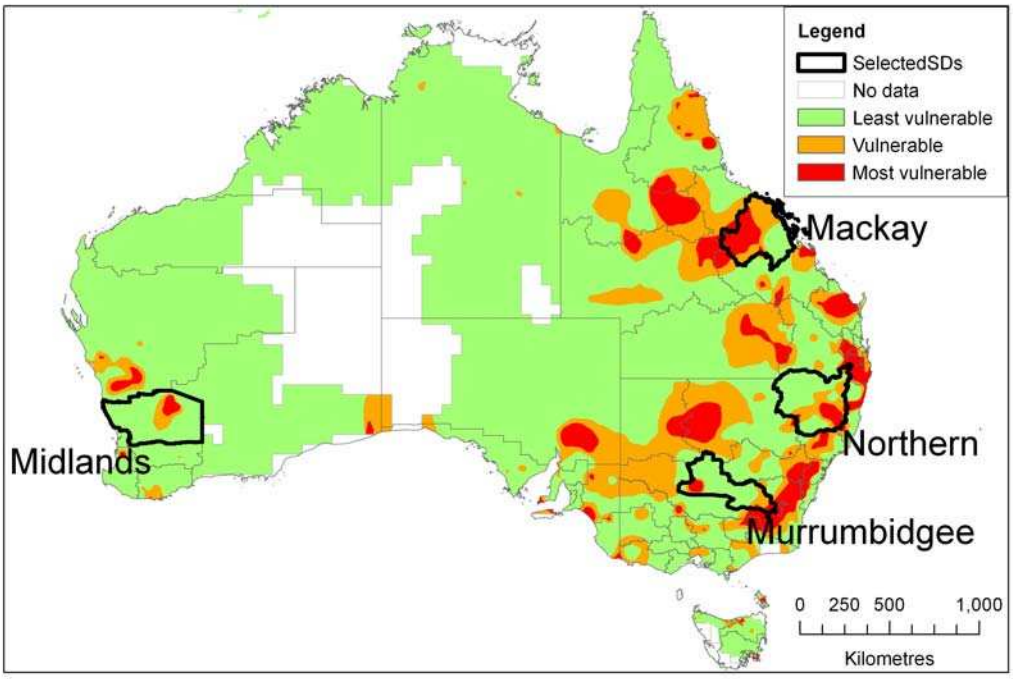
cohesion); natural capital (land, water and biological resources); physical capital (produced by economic activity, including infrastructure, equipment and technology); and financial capital (savings and credit). In order to select the most appropriate hypothetical case studies, we mapped Nelson's index across each statistical division in Australia to illustrate regional vulnerability (Figure 1) and to create a map that we could superimpose on maps of climate change scenarios.

5.3 Importance of agriculture in each region

In addition to selecting areas of varying vulnerability to agricultural shocks, we selected areas that are relatively more dependent on agriculture than on other industries; these would be more at risk of projected downturns. We employed an index used by the Bureau of Rural Science to compare the importance of income earned from agriculture relative to income earned from other industries in each region for statistical divisions in 2006 (Climate and Agricultural Risk Analysis Centre of the Bureau of Rural Sciences, 1999). Industries were classified according to Australian and New Zealand Standard Industrial Classification 1993. Using this method, incomes for each industry were rank ordered and expressed as a percentile. The higher is the percentile rank, the more important agriculture is relative to other industries in the statistical division. A value of twenty, for example, means the incomes of persons in the agriculture industry were in the bottom twenty percent/top eighty percent of incomes from industries in the region. Bearing in mind that agricultural incomes tend to be very low, a rank of twenty indicates that agriculture is an important industry in the statistical division.

Figure 2 shows this index mapped for 2006 (Australian Bureau of Statistics, 2008) with percentile ranks grouped into tertiles of statistical divisions.

Figure 1 Agricultural vulnerability index based on farm survey data, showing hypothetical case study statistical divisions



Our selected statistical divisions all have incomes in the mid-tertile, which suggests these are regions in which agriculture made a relatively large contribution to the livelihoods of residents overall in 2006. We selected mid-tertile regions, additionally, to avoid bias, as we know that the regions in the high tertile tend to be sparsely populated and not representative of most agricultural communities.

5.4 Grazing yield changes

Climate scientists at the CSIRO sustainable ecosystems division and Queensland Department of Natural Resources and Water have produced response surfaces of mean grazing yields to CO_2, rainfall and temperature by statistical division (Crimp & McKeon, 2008). These response functions are expressed as:

$$\% \text{ Yield change} = \text{constant} + (dt*(T)) + (dr*(R)) + (dco_2*(CO_2)) + (dtdr*(T*R)) + (dtdco_2*(T*CO_2)) + (drdco_2*(R*CO_2)) + (dt^2*(T)^2) + (dr^2*(R)^2) + (dco_2{}^2*(CO_2)^2) + (dtdrdco_2*(T*R*CO_2))$$

where T and R respectively are temperature change (^oC) and rainfall (percentage change) from the baseline period, and CO_2 is expressed in parts per million. The constant and coefficients: dt, dr, dco_2, dtdr, $dtdco_2$, $drdco_2$, dt^2, dr^2, $dco_2{}^2$, and $dtdrdco_2$ are parameters for the climate variables and their interactions for each statistical division. We applied these to estimate yield changes for each statistical division (Figure 3).

Figure 2 Incomes for agriculture relative to other industries (percentile rank), 2006

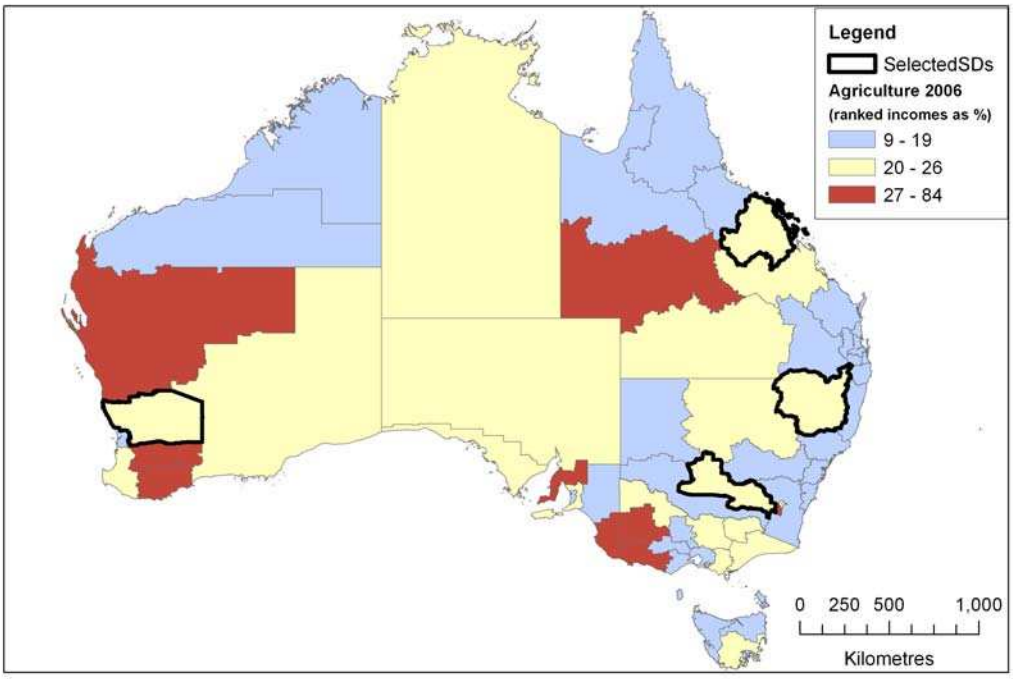


Table 2 and Figure 4 present a summary of projected changes to yields for grazing in the dry and wet scenarios in the medium term (2030) and in the longer term (2060). The hypothetical case studies show that, for grazing, in the dry scenario in 2030, the two high risk regions will experience markedly larger downturns in productivity, with the high vulnerability region (Midlands) the worst affected of all. These circumstances are replicated in the 2060 models, but to a much greater degree. Under these conditions, grazing may not be feasible in the high risk regions, or even in the low risk regions.

Table 2 Hypothetical case studies for grazing yields under selected scenarios

	2030 yields		2060 yields	
	Dry	**Wet**	**Dry**	**Wet**
High risk, high vulnerability (Midlands)	17% lower	2% higher	45% lower	5% higher
High risk, low vulnerability (Murrumbidgee)	12% lower	4% higher	35% lower	10% higher
Low risk, high vulnerability (Mackay)	5% lower	8% higher	23% lower	18% higher
Low risk, low vulnerability (NSW Northern)	7% lower	5% higher	22% lower	14% higher

In 2030, in low risk regions, communities will be very substantially negatively affected with consequent increases in risks to mental health. For these communities, adaptive strategies would need to be urgently considered. For high risk communities in 2030, downturns in yields are so substantial that grazing may not be feasible: either extraordinary adaptation would be required, or the communities may need to change the mix of their industry base to largely exclude agriculture. Many communities that have faced such circumstances have closed down. Where this may be a risk in the medium term, early intervention to ensure a planned and orderly closure of such communities would assist in mitigating adverse mental health impacts. With more extreme outcomes likely in 2060, the same arguments would apply, but to a much more significant degree. In 2060, grazing may not be feasible in any of the hypothetical case study regions.

The picture for the wet scenario is quite the opposite, with increases in yields everywhere in 2030—though relatively less in the high risk regions. These changes are amplified in 2060. While, overall, this is likely to benefit these regions, it must be noted that inequality increases progressively from 2030 to 2060, with the high risk regions faring relatively less well than the low risk regions. With strong associations between inequality and mental health, even improvements in yields may be associated with an increase in mental health problems in relatively less advantaged regions.

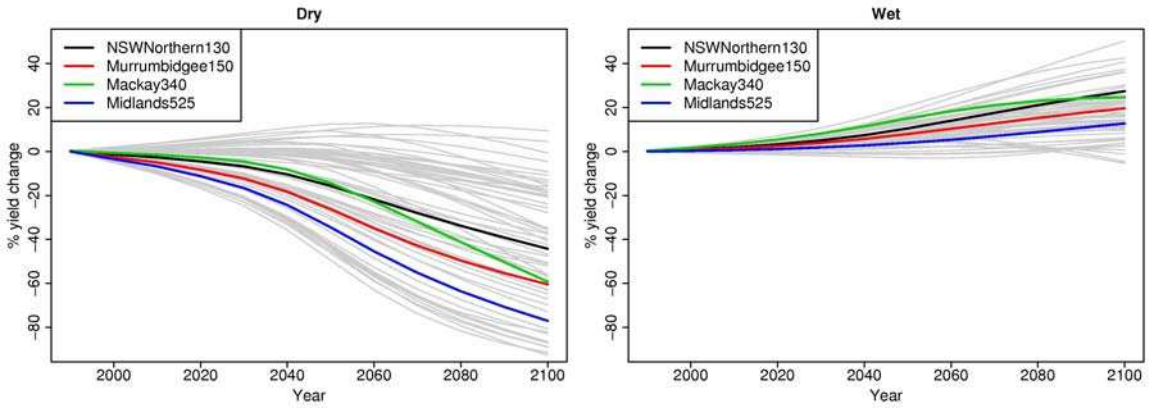
5.5 Wheat yield changes

Climate scientists at the CSIRO sustainable ecosystems division have produced response surfaces of mean wheat yields to CO2, rainfall and temperature changes. These response surfaces were developed using empirical data from ten sites from across the Australian wheat belt (Crimp & McKeon, 2008). The response function can be expressed as:

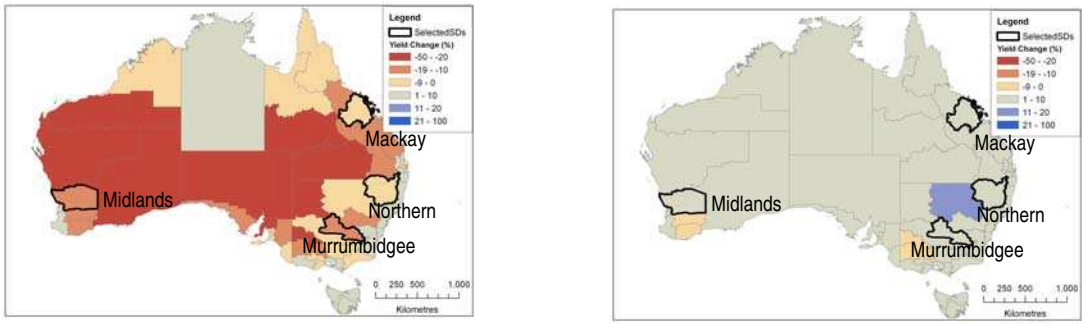
$$\%\ \text{Yield change} = (aCO_2 + b(CO_2)^2 + c(CO_2)^3 + d(CO_2)^4 + e(T) + f(T)^2 + g(T)^3 + h(R) + i(R)^2 + j) \times 100$$

where T and R respectively are temperature (^oC) and rainfall change from the baseline period (proportional change from baseline: i.e. –0.7 = 30% less rainfall and 1.2 = 20% more rainfall), where CO_2 is expressed in parts per million, the coefficients a-i are estimated parameters for each weather variable for each site, and j is a constant for each site.

Figure 3 **Projected changes to grazing yield under scenarios (coloured lines in top row) and mapped scenarios in 2030 and 2060**



2030



2060

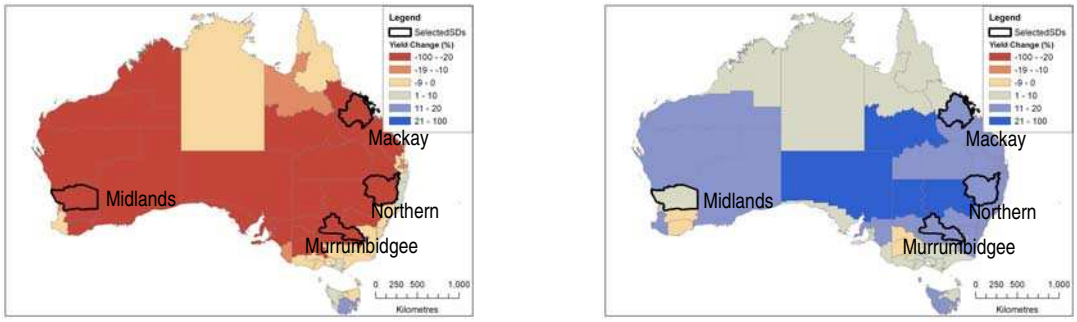
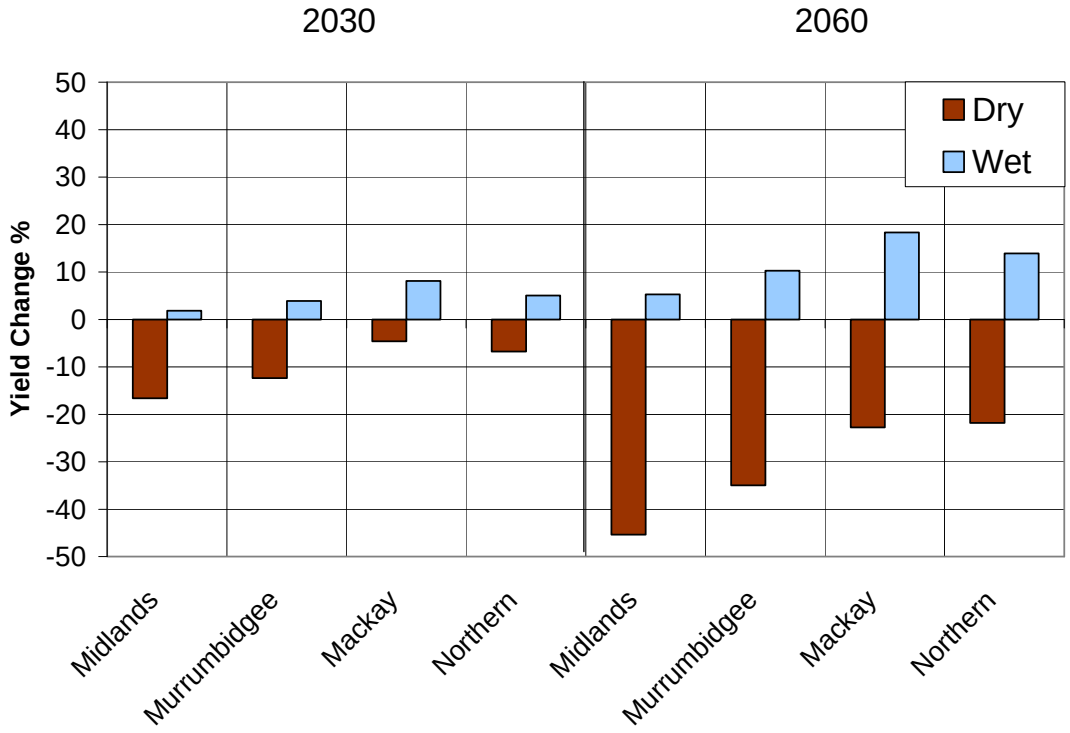


Figure 4 **Hypothetical case studies for grazing yields under selected scenarios showing projected yields for statistical divisions**



We used the closest CSIRO site for each statistical division in the wheat cropping region to estimate yield changes for 2030 and 2060, and these are shown in Figure 5. The four selected statistical divisions are shown as coloured lines, and identified in the maps for 2030 and 2060 by bolded boundaries. The modelling envelope used limits temperature changes to an increase of up to 4^{o}C above current temperatures and +20% to –30% change in rainfall. Beyond these limits the models are unacceptably unstable. As we were not able to calculate changes beyond this climate envelope, many of the lines in Figure 4 (top row) stop prior to the year 2100. Where this occurs, we have been unable to project percentage changes to yields, as reflected in Table 3 (as we were not able to project yields to 2060 in all cases, we have not produced a Figure to illustrate the material presented in Table 3). Extrapolation in these cases suggests very extreme downturns in yields.

In these models, we assume no changes to wheat variety or planting window, although both may occur, as they already have—with considerable success—in some agricultural businesses. Should such changes occur, we would need to consider the possibility of mental health benefits and costs, or both, due to optimism or, more likely, to anxiety about required changes to the structures of farm businesses and the skills of farming people. Those who have been first to implement such reforms are likely to be those with the greatest psychological resources (for example, confidence, optimism, emotional intelligence, business-mindedness, natural resilience) and, therefore, the least vulnerable to mental health problems. All persons will not have these capacities or be able to respond in the same ways.

Figure 5 **Projected changes to wheat yield for hypothetical case studies (coloured lines in top row) and mapped scenarios in 2030 and 2060 (wheat belt also outlined)**

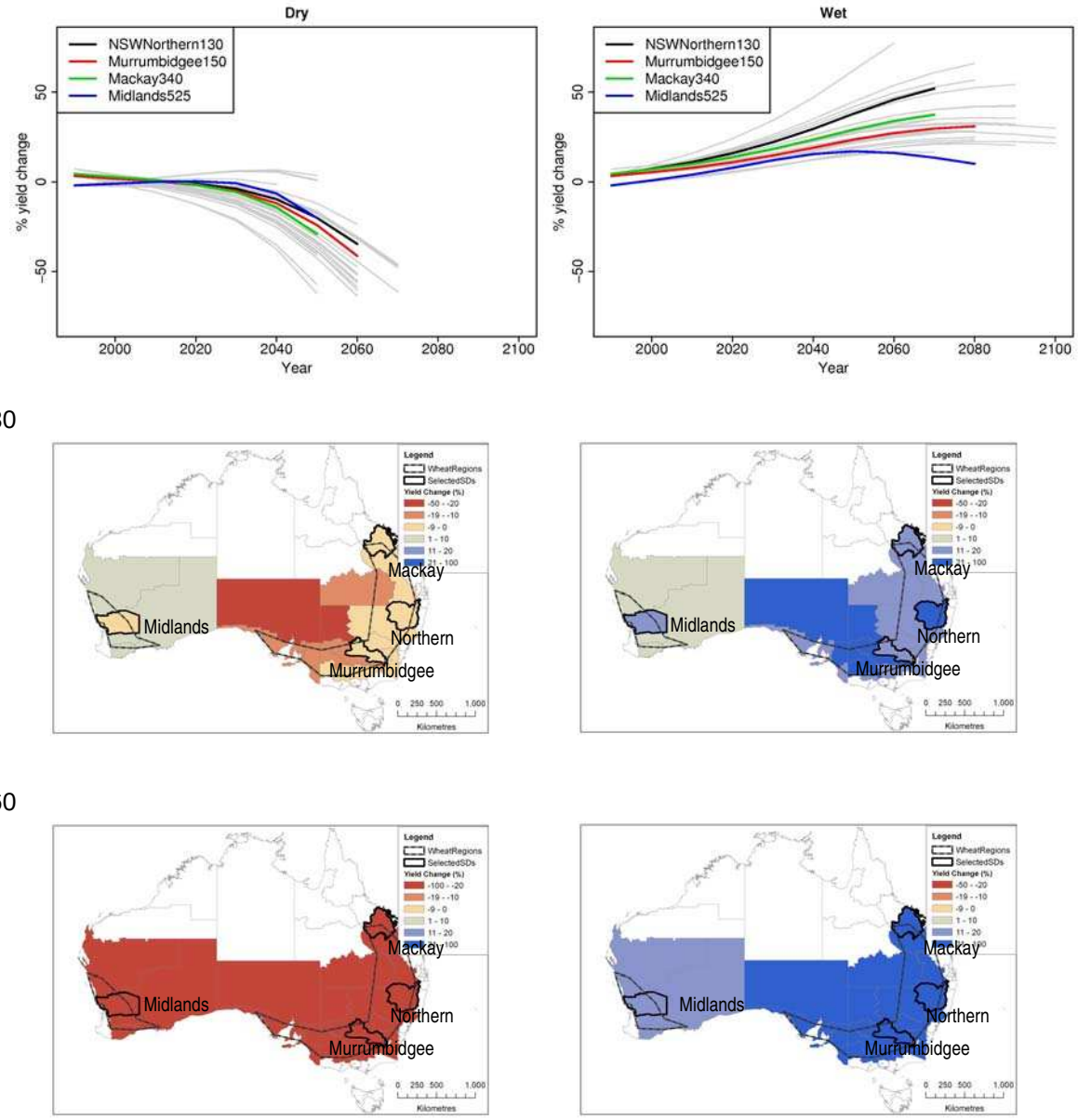


Table 3 presents a summary of projected changes to yields of crops in the dry and wet scenarios in the medium term (2030) and in the longer term (2060).

Table 3 **Hypothetical case studies for wheat cropping yields under selected scenarios**

	2030 yields		2060 yields	
	Dry	**Wet**	**Dry**	**Wet**
High risk, high vulnerability (Midlands)	1% lower	12% higher	20% lower*	16% higher
High risk, low vulnerability (Murrumbidgee)	5% lower	15% higher	41% lower	27% higher
Low risk, high vulnerability (Mackay)	6% lower	18% higher	29% lower*	34% higher
Low risk, low vulnerability (NSW Northern)	4% lower	22% higher	35% lower	46% higher

* Projections are for 2050 because values fall outside the maximum tolerance for modelling (very substantial negative impacts may be expected).

For wheat, the interpretation of changes to yields relative to vulnerability is less clear-cut because, in the dry scenario, all regions are severely negatively affected in 2030 and very severely negatively affected in 2060. In 2030, in the dry scenario, substantial mitigation would be required to maintain productive wheat farming. In 2060, wheat farming would be unlikely to be feasible in any region and alternative industries may be required—though an important modifier of our projections is that changes to wheat variety and planting window (Crimp, Howden, Power, Wang, & De Voil, 2008) may be a successful mitigation strategy. Again, where there may be a risk of community closures, it will be important to manage these in an orderly and planned manner to minimise unmanageable impacts on mental health.

The picture for the wet scenario is very positive, with increases in yields everywhere in 2030 through 2060—though relatively less in the high risk regions. Again, we note that inequality increases progressively from 2030 to 2060, with potential negative consequences for mental health in the relatively less advantaged regions, as described under the grazing hypothetical case studies above.

5.6 Concluding comments

It is important to note that, in selecting our hypothetical case studies, we have not selected the most extreme regions in terms of risk or vulnerability. As such, our projections may be on the moderate side and this should be taken into account in considering potential outcomes for more at risk and vulnerable regions. The mental health issues will be amplified in these regions, with greater consequent need for upfront planning and management of the consequences of climate change to these regions and for more extreme actual climate change.

The absolute effects of climate change outcomes on yields will, of course, be an extremely important predictor of likely outcomes in agricultural regions. Beyond this, underlying socio-economic vulnerability will moderate overall outcomes, including, potentially, under scenarios in which yields increase—because of the relationship between inequality and mental health. In regions in which agriculture is a relatively important part of the industry base, consideration will need to be given to very substantial adaptation, including perhaps a comprehensive change to the local industry mix, or even to the possibility of community closure. Where regions are both vulnerable and at risk, such as in the Midlands in our hypothetical case studies, extreme difficulties may be expected.

We note that our yield projections differ markedly depending on whether we use the dry or wet scenario and, to a lesser extent, on whether we model wheat or grazing, and this confuses assessment of the risk axis. The key message here is that policies and responses will need to be contextual and to focus on building resilience in all communities, particularly the most vulnerable; key priorities for action will be to focus public attention on anticipating and coping with considerable unpredictability of risk.

6 Adaptation to impacts

Building on existing responses, to accommodate the mental health implications of climate change, we advocate an emphasis on public health strategies that are designed to fully integrate social and health policy. These strategies will need to be responsive to individual, household and community needs, address short and longer term policy objectives and have clear roles and accountabilities. Strategies that focus on building strength, and on building *on* strength, dovetailed from the outset with strategies that address risk and vulnerability, will be the most effective.

6.1 Climate change is not all bad for mental health

With this in mind, we note that not all aspects of climate change will have deleterious effects on mental health in rural Australia. Australia's climate has conferred on farmers a leading-edge advantage in world agricultural trade, both for crops and livestock products (Bi & Parton, 2008) and our modelling suggests this could increase. An estimated 30–50% increase in wheat yields from 1952–1992 can be attributed to a climate-change induced steady increase in minimum temperatures; and increasing levels of atmospheric carbon dioxide, together with more sunshine, support photosynthesis. Separately, individuals, households and communities that are already resilient can become more resilient in the face of adversity (Dean & Stain, 2007; Hegney, Buikstra, Baker, Rogers-Clark, Pearce, Ross, King, & Watson-Luke, 2007), including climate change-related adversity. Indeed, the strong social cohesion already present in many rural communities is a source of resilience against extreme hardship (Alston, 2002; Alston & Kent, 2004; Fraser, Judd, Jackson, Murray, Humphreys, & Hodgins, 2002; Hegney, Buikstra, Baker, Rogers-Clark, Pearce, Ross, King, & Watson-Luke, 2007; Judd, Jackson, Komiti, Murray, Fraser, Grieve, & Gomez, 2006; Stehlik, 2003; Stehlik, Gray, & Lawrence 1999; Stehlik, Lawrence, & Gray, 2000; Wainer & Chesters, 2000) and is an important strength on which to build.

6.2 Mental health intervention typology

Adaptations to adversity may occur at different times and at many levels, from individual, through family and community, to regional population and beyond, and can be both spontaneous and planned. The latter may arise via the agency of government policy and professional intervention, or they may emerge from local community initiative and action. Because they are many and varied, it is helpful to categorise strategies for mental health interventions. We recommend adapting a typology that was developed for addressing mental health problems among income support recipients (Berry & Butterworth, 2003; Butterworth & Berry, 2004), itself adapted from a model proposed by Dooley and Catalano (2000). Their model has two dimensions. Consistent with the approach recommended in the Australian *National Mental Health Plan 2003–08* (Department of Health and Ageing, 2003), the first describes the timing of the intervention in four stages: (i) proactive primary prevention, which involves avoiding exposure to risk, (ii) reactive primary prevention, preventing mental health problems developing as a result of exposure, (iii) secondary prevention, early intervention to address early symptoms and (iv) tertiary intervention, managing psychiatric disorder. An alternative nomenclature, based on Mrazek & Haggerty (1994:24–25) for three of the time points for mental health interventions is perhaps more intuitive. These are 'universal' (proactive primary), 'selective' (reactive primary) and 'indicated' (secondary).

The second dimension of the Dooley & Catalano model is the level at which the intervention is targeted, reduced by the authors, for simplicity, to micro interventions targeted at individuals and households and macro interventions targeted beyond individuals and households. We recommend greater specificity in targeting, to take account of the nested structure of Australians' lives—individuals living in households, which are clustered in communities, which are located within regions of Australia, which are sub-sets of one or more states, and so on. While state/territory, national and international levels of analysis are important, for understanding the impact of climate change on rural mental health in Australia, we suggest focusing on the first four levels of intervention mentioned: individual, household, community and region. A matrix showing the timing (rows) and levels (columns) of interventions, together with examples of activities that might be appropriate, is presented in Appendix 1. It should be noted that timing, levels and particular interventions do not, of course, sit neatly within

each cell in the matrix. Nevertheless, the typology offers a convenient mechanism for discussion and analysis. Examples of how it has been or might be implemented appear in the next section.

7 Strategy and policy implications

7.1 Privilege and regional leadership

The economic costs of mental health problems are not only apparent in developed economies, but also in developing economies (Harpham, Grant, & Rodriguez, 2004; Patel & Kleinman, 2003). Australia occupies a leadership position in the Asia Pacific region and its policy settings and approach to intervention design will likely set an example to others, particularly in developing countries in our neighbourhood. It is important that, where possible, we adopt policies that are effective, translatable to other cultures and circumstances, and highly cost-effective, not outside the reach of our neighbours' expenditure capacity. The need to be considerate of our neighbours' economic circumstances with respect to the mental health impact of climate change in rural and remote localities also has implications for our international aid programs.

7.2 A population-based approach to mental health resilience

It goes without saying that, should the prevalence of mental health problems rise, as predicted, there will be a consequent increase in need for a range of services and assistance. There is already a significant under-provision of required services but, despite this, we do not advocate structuring planning *primarily* around supplementing these services. There are effective interventions available for mental health problems that reduce the disability and suffering associated with these conditions. Regrettably, in Australia, as in most countries, only a minority of people with mental health problems receive such treatments (Andrews, Issikidis, & Carter, 2001; Wang, Aguilar-Gaxiola, Alonso, Angermeyer, Borges, Bromet, Bruffaerts, de Girolamo, de Graaf, Gureje, Haro, Karam, Kessler, Kovess, Lane, Lee, Levinson, Ono, Petukhova, Posada-Villa, Seedat, & Wells, 2007). As climate change increases pressure on rural mental health, the already small proportion of Australians receiving treatments will decline differentially in rural areas, where there is already more limited access to services than there is in metropolitan centres. Service models are needed that can be readily applied and are appropriate to rural geography and populations. In regards to improving access to services for isolated populations, health services can be made to work more effectively by using front-line 'gate-keeper' agencies. This approach is of particular use where such agencies are already established in the agriculture sector, where they are important contact points for people in farming communities in distress (Fuller, Kelly, Sartore, Fragar, Tonna, Pollard, & Hazell, 2007).

A range of interventions is needed to encompass primary prevention, early (secondary) intervention for those in early stages of distress or at high risk of mental health problems, and late stage (tertiary) prevention, in the form of effective services to ensure recovery and reduce disability. To achieve such a broad-based approach requires novel partnerships with rural community organisations, welfare services and health services in rural settings. A model for such a framework has been established, providing evidence-based priorities in a coordinated approach to maintaining and improving the mental health of people in farming (Fragar, Kelly, Henderson, Tonna, & Peters, in press). The approaches taken need to ensure that the existing sources of support and assistance (such as existing social networks and community agencies) are promoted and strengthened, and can be extended to reach those who may not be connected with such networks.

In many instances, it is likely that rural communities will be most directly affected by the impact of climate change policy on issues such as water access usage and changing agricultural practices. We must also consider the emotional and social impact on rural peoples of the prospect of climate change and its effects into the future. We do not yet know how such growing recognition of long-term climate change affects morale, hope and views of the viability of some existing rural communities. This may be especially pertinent to children and young people, who did not create but will have to deal with what those who have come before have done to our environment.

7.3 Universal interventions—the Stirling County Studies

Climate change-proofing, especially drought-proofing, rural and remote communities will be essential. Not only is it a practical requirement, it offers an opportunity for creative excellence in intervention design, incorporating strategies with multiple social, economic and health benefits. Indications of how

to manage universal mental health interventions at the community level can be traced back to a seminal set of studies by Alexander Leighton and his colleagues. They charted the transformation, over some twenty years, of the impoverished and marginalised inhabitants of a small rural slum in Canada, 'The Road', into an 'integrated community' as prosperous, happy and productive as any other in the region (Leighton, 1965). From a pervasive culture of despondency and alienation, the people of The Road acquired the skills and motivation to take charge of their lives and of the development of their community. Their descent into poverty and degradation appears to have originated from the erosion of their language and culture of origin, and from a comprehensive loss of economic opportunity. Prominent among the debilitating features of their circumstances were hostile mistrust of each other, especially of strangers, lack of cooperation to solve problems and ways of behaving and dressing that marked them out in a negative manner in the surrounding region. Leighton found 'broken homes, few and weak associations, inadequate leadership, few recreational activities, hostility and inadequate communication, as well as poverty, secularisation and cultural confusion' (Leighton, Harding, Macklin, Hughes, & Leighton, 1962, p.1021).

The people of The Road did not initiate their own recovery (Leighton, 1965). Local government officials, prompted by Leighton, intervened at the community level, offering tangible and cultural resources based on three strategies. The first was to facilitate the development of leadership skills to encourage 'social organisation' and social values. The remaining two were education and economic opportunities. The process of change started with encouraging residents to cooperate to achieve a single goal, to be determined by the community. This goal was to raise enough money to introduce electricity into the schoolroom so that movies could be shown. In being required to achieve this goal independently, residents developed basic leadership and cooperation. Their goal was achieved, becoming the template for the next, and so on, until the community became practiced at solving problems and cooperating to reach shared goals. Over time, future-oriented and public-spirited values emerged within the community, along with rising levels of formal and informal social participation. The Road was eventually able to integrate itself completely into its region, increasing its rate of progress. At no point were mental health problems made a focus of the intervention; yet psychiatric morbidity returned from their initially extreme levels to the same level as were prevalent in the surrounding communities.

Though few rural or remote communities could be described in the terms in which Leighton described The Road, there is much to learn from his studies. A key message is not to focus interventions *directly* on mental health (problems) but to focus on articulating and striving towards desired outcomes, as specified by communities themselves. The achievement of these goals, especially the process necessary to achieve them, will address many mental health problems and risks *indirectly*. Recent Australian research findings are suggestive of community and family, rather than individually-based, interventions, as more effective in raising awareness of mental health issues and increasing help-seeking behaviour for rural communities dealing with drought (Alston, 2002; Alston & Kent, 2004; Fuller, Edwards, Procter, & Moss, 2000; Fuller, Kelly, Sartore, Fragar, Tonna, Pollard, & Hazell, 2007; Jorm, Christensen, & Griffith, 2005; Judd, 2005, 2006; Judd, Cockram, Davis, Fahey, Hodgins, Jackson, & Scopelliti, 2003; Judd, Jackson, Fraser, Komiti, Hodgins, Pattison, Humphreys, & Robins, 2004; Judd, Jackson, Komiti, Murray, Fraser, Grieve, & Gomez, 2006; Judd & Humphreys, 2001; Sartore, Hoolahan, Tonna, Kelly, & Stain, 2005; Stehlik, 2003; Stehlik, Gray, & Lawrence 1999).

7.4 Community participation as an effective universal mental health promotion intervention

Mental health researchers, clinicians, carers, and people with mental health problems point to the inadequacy of mainstream mental health services (Hickie, Davenport, Scott, Hadzi-Pavlovic, Naismith, & Koschera, 2001) and to the extensive unmet need (Andrews, Henderson, & Hall, 2001; Andrews, Issikidis, & Carter, 2001; Herrman, 2001; Ialongo, McCreary, Pearson, Koenig, Schmidt, Poduska, & Kellam, 2004), especially in deprived areas (Abas, Vanderpyl, Robinson, & Crampton, 2003). In Australia, at most, one in six people with mental health problems gets effective treatment (Andrews, Issikidis, & Carter, 2001). Indeed, mental health problems are so pervasive that clinical services cannot hope to meet treatment needs to an acceptable level. Safe, effective and affordable interventions, particularly those that attack avoidable triggers to psychiatric illness, such as social isolation (Riise & Lund, 2001), are urgently needed (Berry, 2008). Participating in the social and civic life of communities is protectively associated with the onset, course and resolution (or not) of physical

and mental disorders. It is considered important in achieving health promotion goals, including mental health goals. This is the case throughout the life course, among immigrant and ethnic groups and, of particular interest here, in rural and remote locations (Wainer & Chesters, 2000). For a review of this literature, see Berry et al. (2007).

Participation may be a valuable health opportunity for everyone, but it is not evenly available across the population. Certain ethnic (Lindstrom, 2005) and socio-economically disadvantaged groups report low levels of community participation and elevated levels of associated health problems (Baum, Bush, Modra, Murray, Cox, Alexander, & Potter, 2000). Strategies that encourage increased involvement in *protective types* of community participation could form an effective component of a broad-scale, socially-based mental health approach (Berry, Rodgers, & Dear, 2007). But they need to be tailored to carefully specified characteristics of target groups, taking account of gender, life stage, family structure and, especially, socioeconomic disadvantage (Berry, 2008). Perceptions about i) what level of participation is desirable and ii) how enjoyable it is, are important for mental health too (Berry, 2008): for participation to be an effective mental health promotion intervention, it must be sufficient, yet manageable within people's time constraints, enjoyable and, for men, not unenjoyable.

7.5 Participation is amenable to intervention

Participation is strongly associated with higher levels of social cohesion (Berry & Shipley, 2007) and is amenable to intervention in a way that social cohesion is not (Berry, 2008): compared with providing, for example, psychiatric services to address individual issues of trust or belonging, it is relatively efficient, inexpensive and administratively straightforward to increase appropriate types of community participation. Together, community participation and social cohesion make up social capital, higher levels of which are strongly associated with benefits to mental health. There are distinct groupings of people within communities in terms of their levels of social capital and associated mental health, suggesting the need for service differentiation (Berry, 2008). Services as simple as transport, particularly for older people and for those living in rural and remote locations, could substantially improve participation (Berry, 2008). This may be of particular value for older rural Australians, who have increasing mental health service needs as they age and who also contribute disproportionately generously to the building and maintenance of social capital (Davis & Bartlett, 2008). In addition to potential benefits to mental health, increased participation in rural communities generally could be expected to raise levels of social cohesion and, consequently, to overall stocks of social capital, contributing to decreases in other health and social problems.

7.6 Participation-based strategies cannot be developed solely by elites

Consulting with the intended recipients of services is essential but it must be borne in mind that community consultation processes often, inadvertently, capture the views of the most privileged in the community, sometimes known as the 'elite' (Berry, 2008). In general, society's elites engage more deeply and broadly than do other groups and they assume leadership roles and exercise the most influence, particularly through their civic and political participation (Heying, 1997; Putnam, 1995; Skocpol, 2000). Though, according to these studies, elites have by far the greatest say in their communities, with their distinct and advantaged socio-demographic and participation characteristics, the voice of elites may not always reflect the needs or views of all groups. It will be essential to identify and access a full range of stakeholder groupings, including those with limited or no voice, and to consider how to respond to patterns of inclusion and exclusion that sit behind their sometimes complex perspectives (Berry, 2008): the imperative to confront issues of elite power and influence has been directly implicated in the use of community participation and capacity-building as health promotion strategies (Wakefield & Poland, 2005).

7.7 Participation-based strategies must be tailored to specific groups

Targeting services to those that most need them and tailoring them to fit is a perennial public policy challenge (Berry, Butterworth, Caldwell, & Rodgers, 2008). Health services are disproportionately accessed by those who least need them, but who have the resources to find and take advantage of them (Quine, Kendig, Russell, & Touchard, 2004). Those experiencing ill-health (Buetow & Kerse, 2001) and other disadvantage (Eckert, Taylor, & Wilkinson, 2004; Turrell, Oldenburg, Harris, & Jolley, 2004) sometimes lack these resources (education, transport, time) and miss out. This is an issue of social justice which social policy must confront (Wakefield & Poland, 2005). It also has practical

implications for participation-based health promotion. The key point is that, to be effective, interventions need to be differentiated and adapted to the circumstances of intended recipients, especially for poorly connected people (Lee, Draper, & Lee, 2001) and for people with intransigent problems (Juvonen-Posti, Kallanranta, Eksyma, Piirainen, & Keinanen-Kiukaanniemi, 2002; Quine, Kendig, Russell, & Touchard, 2004). This requires accurate information about target groups (types of people according to characteristics of interest), the involvement of all appropriate government agencies and the participation of policy-sensitive researchers in the policy-making process (e.g. Brownson, Royer, Ewing, & McBride, 2006).

7.8 Selective and targeted interventions: Examples of effective responses by States and Territories

In response to increasing knowledge on the effects of drought on mental health, a number of recommendations have been put forward to help drought-affected communities deal with issues surrounding mental health. These include strategies to increase collaboration between government and rural organisations that undertake mental health promotion programs, aid and promote early intervention programs and improve alignment of services offered by all levels of government and non-government agencies (Sartore, Hoolahan, Tonna, Kelly, & Stain, 2005). These strategies should facilitate local planning, especially when health services are supporting the leadership taken by community organisations in addressing mental health needs in situations, such as drought. If effective, these programs could be expected to (i) deliver a sustainable improvement in service responsiveness to the mental health needs of rural populations, (ii) build confidence in people with mental health problems to seek help and (iii) reduce stigma associated with mental health problems, thereby increasing the likelihood that people will provide helpful advice to those with mental health problems (Fragar, Kelly, Henderson, Tonna, & Peters, in press).

In response to suggestions such as these, State and Territory governments have developed initiatives which support such recommendations. For example, the Victorian Department of Human Services developed the ‘Tackling Mental Health’ Drought Initiative, which aims to strengthen ties between community health and family services with Primary Care Partnerships (Department of Human Services, 2006). Specific programs in this initiative include providing individuals, service providers and communities with increased levels of counselling, training and information on mental health issues in rural areas.

The NSW government developed the Drought and Mental Health Assistant Package, which raises awareness of mental health issues and aims to increase the capacity of individuals, service provides and communities to deal with mental health problems (Department of Health, 2008). Programs within this initiative included: a number of mental health literacy workshops; Service Network meetings to improve links between service providers; community events (which increased mental health literacy); and the development of mental health resources for people with mental health problems and for service providers. A review of this package concluded that a strength of this project was that it built a strong collaboration between partner organisations from government and non-government sectors who participated in the design and promotion of the activities.

7.9 Service integration and continuity

Service integration and continuity, and supportive, continuous policy, are essential to ensure positive mental health outcomes in rural Australia (Alston & Kent, 2004; Botterill, 2003a, 2007; Botterill & Cockfield, 2006; Fraser, Judd, Jackson, Murray, Humphreys, & Hodgins, 2002; Fuller, Kelly, Sartore, Fragar, Tonna, Pollard, & Hazell, 2007; Judd, 2006; Judd, Murray, Fraser, Humphreys, Hodgins, & Jackson, 2002; Wainer & Chesters, 2000). Integrating mental health care and training with other general health services under the DART-R General Practitioner Program has been successful in the Southern Mallee region of Victoria (Judd, Cockram, Davis, Fahey, Hodgins, Jackson, & Scopelliti, 2003). Models of community-led frameworks for improving the mental health and wellbeing of people in farming, using existing evidence in mental health promotion, prevention and early intervention have also been successful (Fragar, Kelly, Henderson, Tonna, & Peters, in press). Similar collaborations between local services, researchers and practitioners, with an emphasis on awareness-building, education and training have been successful, too, in alleviating anxiety and depression in rural Victoria (Judd, Jackson, Davis, Cockram, Komiti, Allen, Murray, Kyrios, & Hodgins, 2001).

8 Recommendations for future research/activity

8.1 Evaluating public health strategies

We consider that there is room for more frequent and more rigorous evaluation of public health strategies; indeed, public health efficiencies and greater effectiveness could be achieved if there were routine investment in scientifically informed policy and intervention evaluation. Existing strategies for mental health promotion need to be evaluated in terms of their relevance to climate change challenges, with a view to modification, continuation or extension. Where new strategies are considered necessary, an evaluation approach that takes account of climate change may be designed upfront for, at least, (i) baseline, (ii) immediate-post and (iii) longer-term post intervention evaluation.

In terms of the disease burden of mental disorders, mental health is substantially under-funded in Australia (Jorm, Griffiths, Christensen, & Medway, 2002) and many potentially useful avenues of research remain unexplored. Evaluations of mental health promotion strategies would offer their greatest returns if dovetailed into mental health research and development programs. An Australian Society for Health Research report discussing methodologies to quantify the impact of health interventions demonstrated stunning returns on investment in health research and development (Access Economics Pty Ltd, 2003). The systemic nature of the disruption of rural production, livelihoods, community functioning and family and individual health necessitates a broad inter-disciplinary program of research that clarifies the relationships between these sectors and sub-systems. Indeed, this is a central challenge that climate change (with its unprecedented scale, complexity and forward-dimension) poses to researchers in general. Responding to that challenge will help develop much-needed capacity, lacking in the past because of the newness of the topic and the predominance of differentiated, discipline-based, research.

Some key research priorities are:

1 Determining the relationship between changes in climate and mental health, especially common mental health problems, in rural individuals and households.

2 Studies of how children respond to the risks posed by climate change. The consequences for emotional development and behaviour need to be understood, to facilitate community education and family interventions.

3 Developing links with climate scientists and modellers to explore how future climatic variability and extreme weather events will affect population mental health.

4 Studies to identify and understand which groups and communities are at particular risk (in consultation with communities and stakeholders).

5 Developing a broad-based research program for understanding the risks to rural Australia, to map the pathways that link impacts on livelihoods, local environments and community functioning to mental health.

6 Research on how emissions mitigation strategies, such as energy-related changes in the ways we design, live in and move ourselves around our environment, can provide additional, immediate, mental health gains.

7 Developing systematic approaches to identifying, evaluating and implementing adaptive strategies to lessen the mental health risks of climate change, especially in vulnerable groups.

8 Building research capacity in evaluation of programs to assist communities to adapt to climate change impact.

9 Building research-policy capacity; using scientific evaluations of policy initiatives, programs and interventions to help academic researchers and policy-makers to work together.

10 Building climate-related health factors into medical training and primary mental health workforce development.

11 Developing a longer term strategy of research targets, and related tasks in building the research base and the capacity required to achieve these targets.

12 Building a strong collaboration in these long term research targets with key rural stakeholders and with all levels of government and the non-profit service-delivery sector.

13 Investigate perceptions of climate change impact and the social and emotional consequences of threat of climate change.

14 Ensuring that we understand, can describe and can measure accurately aspects of climate and climate change, and that these conceptualisations and measurement approaches are standardised and widely understood and used in Australian research.

15 Developing methodologies for translating and explaining the findings of research and their ramifications to communities in ways that inform, encourage confidence and promote adaptive behaviour and that do not frighten or paralyse responsive capacity.

Appendix 1 Typology of interventions and example approaches within each intervention

	Intervention level (Micro to Macro)			
	Individual	**Household**	**Community**	**Region**
1. Proactive primary prevention (Universal) *Preventing exposure to climate change risks*	General education, training and personal development (e.g., in schools and adult educational or workplace settings); social skills, individual community participation.	General household strengthening & skills development (e.g., building better relationships; financial management; whole family community participation) using existing services & frameworks; increase participation in community; assist families in tasks of adaptation, problem solving Focus on life-span perspective (e.g., children youth, parents, older persons).	Social capital building; cultivating initiatives determined by local communities; broad-based education & community competencies training to achieve community-driven goals (e.g., economic, water or food security); resilience-building for whole or parts of community.	Regional economic & social development; encouragement of new businesses, industries, technologies; enhanced general education & skills training; links to other policy areas (e.g., policing, immigration); acceptance and valuing of cultural diversity (e.g., in identifying impacts of climate change on all members of the community); identify potential impacts on ATSI people; role of media and local government in promoting adaptation to change. Planning how to use media for public awareness. Managing stakeholder relationships.
2. Reactive primary prevention (Selective) *Preventing MH symptoms from developing as a result of exposure*	Specific MH education, training and personal development (e.g., in schools, adult educational or workplace settings); vulnerable persons targeted.	Specific household-based MH education & skills development (e.g., dealing with adversity, coping skills) using existing services where possible; vulnerable households targeted.	Engagement of broad range of health and human services sectors in mental health promotion programs. Build community leadership in these programs. Community-based mental health promotion, MH literacy, awareness raising; enhance or coordinate health & social services; identify service gaps; train service providers. Vulnerable communities targeted.	Policy & program design, develop information kits, enhance or maintain health & social service infrastructure; fund or advocate for new services. Link in with State and Federal governments. Coordination of emergency services sector, rural assistance agencies. Use of media for public awareness. Vulnerable regions targeted.
3. Secondary prevention (Indicated) *Early intervention to treat symptoms in early stage*	Targeted individual crisis intervention or support, for practical (e.g., alternative housing, food, 'beyondblue drought line') or MH needs, counselling.	Targeted household crisis intervention or support, for practical (e.g., alternative housing, food, 'beyondblue drought line') or MH needs, counselling. Build community confidence in health and human services, Programs to overcome stigma of mental health Innovation in outreach programs.	Screening & early identification (e.g., in schools, childcare, police, primary health services); funnelling rapidly into local services; follow-up to prevent relapse or worsening. Engagement of gate-keeper or front-line agencies in improved pathways to assistance; build capacity for intersectoral collaboration in improving access to services; engagement with primary care (GP sector).	Increase availability of effective, low-cost, easy to deliver interventions (e.g., CBT) when needed; regional mobile or outreach services; increase capacity of generalist health and human service sector to provide basic mental health care when needed across all age groups and build greater links across primary and secondary service sectors. E-health initiatives.

	Intervention level (Micro to Macro)			
	Individual	**Household**	**Community**	**Region**
4. Tertiary prevention *Managing psychiatric disorder*	Professional or medical assistance, long-term case management.	Professional or medical assistance for household with member/s with ongoing MH problem, respite options for carers, long-term household-based case management.	Community level arrangements for integrating & preventing isolation of people and households living with MH problems; alternative employment; long-term options for meaningful structuring of time for those unable to manage paid employment; opportunities for those with MH problems to participate, to (be seen to) contribute to community; role for and valuing of people with MH problems and their carers.	Regional services—full spectrum of health services to include recovery programs with enhanced community based services; increase support to people with MH problems and their carers to overcome isolation, self-help and support groups within range of multiple communities; anti-MH stigma education; options for extremely remote locations (e.g., video-conferencing; telepsychiatry). Use of media for public awareness.

Source: Adapted from Dooley & Catalano (2003) and Berry & Butterworth (2003; 2004).

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