Food security debates have only recently emerged in Australia with the prediction that Australia's population could reach 35 million by 2050. In a country with limited productive arable land and a heavy reliance on inputs, the question is being asked: 'can and should Australia continue to export food and feed itself in the face of changes in the use and ownership of agricultural land, tighter water regulations, increasing input costs, declining numbers of farmers and rural labour, environmental degradation and a changing climate?'. This paper examines the relative importance of these changes, using current information and future scenarios. A brief introduction to Australian agriculture describes the current production and trade environment. Land use, social and environmental changes are then analysed in terms of their impact on the role and future productive capacity of Australian agriculture. We conclude that despite recent declines in farmer populations, available agricultural land and water restrictions, Australia will continue to produce enough food for domestic and export markets at least in the short term with import substitutions as required. Longer term food security for Australia and its trade partners is likely to be threatened by climate impacts (e.g., droughts, flooding, cyclones), lack of planning controls over urban development and mining on productive land, shortages of skilled labour and underinvestment in agricultural research and development.


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Changes in Australian agriculture and land use: implications for future food security.

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Abstract

Food security debates have only recently emerged in Australia with the prediction that Australia’s population could reach 35 million by 2050. In a country with limited productive arable land and a heavy reliance on inputs, the question is being asked “can and should Australia continue to export food and feed itself in the face of changes in the use and ownership of agricultural land, tighter water regulations, increasing input costs, declining numbers of farmers and rural labour, environmental degradation and a changing climate?” This paper examines the relative importance of these changes, using current information and future scenarios.

A brief introduction to Australian agriculture describes the current production and trade environment. Land use, social and environmental changes are then analysed in terms of their impact on the role and future productive capacity of Australian agriculture. We conclude that despite recent declines in farmer populations, available agricultural land and water restrictions, Australia will continue to produce enough food for domestic and export markets at least in the short term with import substitutions as required. Longer term food security for Australia and its trade partners is likely to be threatened by climate impacts (eg droughts, flooding, cyclones), lack of planning controls over urban development and mining on productive land, shortages of skilled labour and underinvestment in agricultural research and development.

Keywords Australian agriculture, food production, food security, future farming, land use planning, rural communities.
Introduction

Predictions of continuing population increases around the globe, and in Australia, are creating concerns and questions about food security in terms of availability, access, utilisation and stability of food and political systems (Booth and Smith, 2001; Campbell, 2009; Van Rheenen and Mengistu, 2009; Pretty et al., 2010; Cribb, 2011). FAO (2009) cited in Pretty et al., (2010) estimate that the world will need to produce 70-100 percent more food to feed a global population of nine billion by 2050 given climate change and energy security scenarios. Food distribution and equity in access are also global challenges to meet the Millennium Development Goal of halving world poverty by 2015.

As a food exporter, Australia may be called upon to produce more food in the future. Australia will also have to meet increasing domestic food demand as the population expands from 22 million in 2010 to a medium scenario estimate of 36 million by 2050 (Commonwealth of Australia, 2010). The question being addressed in this paper is; “can and should Australia continue to export food and feed itself in the face of changes in the use and ownership of agricultural land, declining numbers of farmers and rural labour, tighter water regulations, increasing input costs, environmental degradation and a changing climate?”

Although small in terms of global food production, Australia exports 60 per cent of its total agricultural production, valued at $25-30 billion from 2005-2010 (DAFF, 2011a). Food imports worth $10 billion are mainly processed goods and out of season food to ensure year round supply (DAFF, 2011a). The top three agricultural commodities produced nationally (ranked by gross value) are cattle and calves ($7.4 billion), wheat ($5.2 billion), and milk ($4.6 billion) most of which are exported along with wine, wool, sheepmeat, sugar and cotton (NFF, 2009). Australia’s major agricultural export markets in order of significance are Japan, ASEAN countries, China, European Union, United States and the Middle East (NFF, 2009).

Hence, Australia provides mostly high protein food to nations who can afford the commodities. Short term emergency food assistance and rural development programs are delivered to countries in need, although Australia’s aid expenditure is significantly lower than other OECD countries (DAFF, 2011b). Australia’s aid spending of approximately $4.3 billion for 2010-11 equals 0.33% of the Gross National Income (GNI) and is predicted to increase to 0.5% of GNI by 2015 (AidWatch, 2011). Most aid goes to countries in the Asia Pacific region with recent increases to Africa and the Middle East.

In addition, Australian farmers continue to produce 93% of Australia’s domestic food supply despite a decrease in the number of farmers over the last 25 years (NFF, 2009). This is due to increasing productivity growth during this period estimated at an average of 1.4% per annum (PMSEIC, 2010). Agricultural research and development has fuelled this growth but investment is declining leading to concerns about Australia’s ability to address future production challenges. Australian government subsidies and support to farmers is also minimal representing only 4-5% of farming income, compared to most OECD
countries where support ranges from 62% in Norway to 18% in Canada and 10% in the United States (OECD, 2008).

As a result, Australian farmers are often cited as the most efficient in the world along with New Zealand farmers. However, ongoing declining terms of trade and lack of farm labour has increased economic risk and uncertainty for many Australian farmers, and has led to significant changes in the structure of Australia’s farmer population since the 1970s (Barr et al., 2005).

A 2010 report by the Prime Ministers Science Engineering and Innovation Council stated that ‘Australia is food secure and produces enough food today to feed approximately 60 million people’ (PMSEIC, 2010, p1). However, it was acknowledged that maintaining this level of food security depended on addressing emerging challenges such as; vulnerability to climate variability, loss of productive land in peri-urban areas, soil fertility decline, increasing reliance on production inputs, slowing of productivity growth in agriculture, poor nutrition intake in some social sectors and conflict in the region.

The report concluded, ‘if our population grows to 35-40 million and climate change constrains food production, we can expect to see years where we will import more food than we export (PMSEIC, 2010, p 1). Figure 1 shows the trend to increased imports and variability in exports since 1989-90 due to severe drought from 2000-2006, world price fluctuations and the rising value of the Australian dollar (DAFF, 2011a).

![Figure 1](image_url)

**Figure 1  Trends in value of Australian food trade (DAFF 2011b)**

These trends along with rising concerns about the lack of coordinated food and agriculture policies in Australia, have generated recent debates about food security in Australia. On the one hand, there is the view that investment in technological advances will enable Australia to adapt to change and that being part of a global market will provide necessary food at the cheapest price
(Agriculture and Food Policy Reference Group, 2006; PMSEIC, 2010; DAFF, 2011). Others are less optimistic, citing mounting threats to food security, the environment and human health from globalised food production with calls for more localised forms of production and distribution (Houston, 2005; Hamblin, 2009; Sumner et al., 2010). In this paper, we analyse information on changes to land use and Australian agriculture with views on future scenarios, in an attempt to present a balanced, pragmatic picture of future food security implications for Australia.

Land use changes in Australia

Agriculture occupies 409 million hectares or 53% of total land area in Australia based on 2009 data (ABS, 2010a). The majority of this land is under extensive pastoral use for grazing due to inherently low rainfall and infertile soils (Figure 2). Irrigated areas occupy 0.35% of land area and urban or rural residential 0.34%.

Agricultural land in Australia is being converted to other uses due to urban sprawl around cities and regional centres, subdivision of farms to rural lifestyle blocks, sale or leasing of properties for conservation, timber production, and mining. In the last ten years, there has been a loss of agricultural land from 456 million hectares in 2001 to 409 million hectares in 2009 (a reduction of 5.9 million ha per year) (ABS, 2010a). At the same time, the area of non-agricultural land has increased from 334 million hectares in 2006 to 360 million hectares in 2009 (gain of 26 million ha in only 3 years) (ABS, 2010a). However, there is no national data showing specific trends in land use for those areas going out of agricultural production. A loss of 47 million ha in 8 years is significant but where is it occurring and how much is due to purchase of properties for conservation, lifestyle, mining, forestry or urban residential use? How much of this land is highly productive and how much is low input pastoral grazing land?

The threat of loss of agricultural land to future domestic and export food production has only recently emerged as an issue for debate in Australia (Budge and Slade, 2009; Campbell, 2009; Commonwealth of Australia, 2009; SBS, 2010). Concerns over loss of farmland have largely focused on associated environmental and social impacts such as loss of open space and biodiversity...
(in some cases), decline in rural communities and small towns, and shortage of agricultural labour not agricultural production per se (Cocklin and Alston, 2003; Stewart et al., 2007; Argent, 2008).

The Planning Institute of Australia estimates that the expansion of Australian cities has removed more than one million hectares of rural land since 1945 (Commonwealth of Australia, 2009). Australia’s eight major cities are located in coastal areas except the national capital, Canberra, which is 3 hours inland from the coast. City populations continue to grow at 2.3%, slightly higher than the remainder of Australia at 1.9% (ABS, 2010b). Most of this growth is in the outer suburbs on the fringes of capital cities bordering farmland as in Canada and the USA (Bunker and Houston, 2003; Carruthers and Vias, 2005). For example, the fastest growing suburb of Wyndham in the state of Victoria (8.1%) was previously grazing land on native pastures but still has some intensive agricultural industries. In subtropical Queensland, the largest growth is in the outer suburban area of Ipswich, a former dairy and beef district (ABS, 2010b).

Peri-urban areas play an important role in agricultural production. Although these regions comprise less than 3% of land used for agriculture across the five mainland states, they are responsible for almost 25% of Australia’s total gross value of agricultural production (Houston, 2005). This figure may be conservative due to a significant amount of agricultural production being grown and consumed locally, retailed through Farmer’s Markets and less formal farmgate sales which are not recorded in the census statistics (Budge, 2008). As Campbell (2009, p. 27) states, ‘State and local governments need to recognise the loss of finite areas of productive land around cities as a negative externality requiring strategic intervention.’

However, little is being done to curb urban sprawl into prime agricultural land with reliable rainfall along Australia’s coastline (Bunker and Houston, 2003; Burnley and Murphy, 2004; Gibson et al. 2005). In regional areas, rapid growth is also being experienced in all states, particularly around regional centres such as Mandurah in Western Australia (5.1%), Surf Coast of Victoria (3.9%), Cairns in far north Queensland (3.2%), and the Gold Coast in south east Queensland (3.1%) (ABS, 2010b). With reliable rainfall, good soils and warm climates these areas were traditionally farmed for vegetables, fruit, dairy, beef and sugarcane.

Data on the area of agricultural land being lost annually to urbanisation is currently unavailable in Australia on a national scale despite the obvious trends and growing public concerns. Media coverage on the issue of ‘rights to farm’ in peri urban areas, ongoing land use conflicts and calls for a national food policy are increasing (SBS, 2010). For example, the state government of Victoria has come under criticism for plans to extend the urban boundary of the city of Melbourne into greenbelt areas by taxing landholders and developers to pay for growth infrastructure costs (Weekly Times, 2010). The Planning Institute of Australia estimates that if current trends continue, by 2021, Melbourne will have lost another 25,000 hectares of rural land to urban development (Commonwealth of Australia, 2009). Indeed, Campbell (2009) notes that urban growth strategies seldom account for food production as a strategic resource worthy of protection.
Allowing urban residential development in agricultural areas can generate conflicts between intensive farming and residents over noise or smells from agricultural operations (Buxton et al., 2006; Sinclair and Bunker, 2007). There are some notable policy actions. A right to farm bill was introduced into South Australia in 2009 to enable farmers to keep farming in areas despite urban encroachment. A plan for the greater city of Adelaide included protection of 375,000 hectares of significant agricultural land (Slow Food Australia, 2009), however implementation has yet to be verified.

The other major threat to agricultural land in Australia is subdivision of farms for small rural lifestyle properties occurring in coastal and high rainfall, amenity areas. The movement of people from cities to non-metropolitan areas is a worldwide phenomenon that has been happening for more than thirty years (Burnley and Murphy, 2002; Jones et al., 2003; Loeffler and Steinicke, 2007). In Australia, more than one million people have left metropolitan areas for smaller places between 1970 and 2001 (Burnley and Murphy, 2004).

This is being driven by both ‘pull and push’ factors. The pull factors are city or town dwellers seeking space, amenity and safety (Argent et al., 2007; Gill et al., 2010). Advances in transport and communications, increasing levels of transferable incomes as a result of the minerals boom and a large cohort of wealthy individuals approaching retirement age are also some of the factors driving the so-called ‘amenity migration’ (Mendham et al., 2010).

Push factors relate to farmers willingness to sell their land due to pending retirement, low farm income, lack of family succession and inability to make a return on investment relative to increasing land values (Barr, 2003; Gill et al., 2010). The ability of some farmers to maintain profits or expand their operations is impacted unless they can diversify into high-value commodities and/or sell direct to consumers. Many Australian farmers are reaching retirement age with little prospect of younger generations wanting to continue farming so selling their land becomes a lucrative and in some cases only option for them (Gibson et al., 2005).

However, unlike urban development, rural subdivision has the potential for diversification and development of niche agricultural industries (Gibson et al., 2005; Ecker et al., 2010). Small rural property owners often choose to keep cattle, horses and sheep, or grow crops and trees for timber to offset the cost of buying land in the first place (Gill et al., 2010). They contribute to local food production and tourism through food trails and markets (Ecker, et al., 2010; Slow Food Australia, 2010). However, the contribution of small properties to overall agricultural production is very low compared to large farms (Barr and Karunaratne, 2002).

The largest area of agricultural land conversion in Australia has been to nature conservation. The national reserve system includes more than 9,300 protected areas covering nearly 13 per cent of the country (DSEWPC, 2010). In the last 20 years, non-government conservation organisations have bought over 3.5 million hectares to manage as wildlife sanctuaries involving 52 properties (AWC, 2010; BHF, 2010). The Bush Heritage Fund of Australia aims to protect
one per cent of Australia (more than 7 million hectares) by 2025. Properties are also divested back to indigenous communities with 38 declared Indigenous Protected Areas across Australia covering over 23 million hectares (DSEWPC, 2010). However, most conservation properties are located in semi-arid to arid areas and have low livestock carrying capacity or production potential.

Forestry has emerged as a competing land use to agriculture over the last 30 years, with timber companies buying up properties for blue gum and softwood plantations in southern states (Mendham and Curtis, 2010). Plantations on private land now total 90,000 hectares with a boom in hardwood plantations between 1998 and 2002 (Gavran and Parsons, 2010). Managed investment schemes (MIS) have been the dominant source of private investment in new plantations in Australia and are now managing 35.7% of plantations on private land (Commonwealth of Australia, 2009; Gavran and Parsons, 2010). There has been an impact on local communities due to loss of farm families and a drain on social capital in some districts. There is also concern over lowering of water tables as plantations grow (Stewart et al., 2007).

An expansion of mining due to the mineral resources boom is forcing some landholders to stop farming or sell their properties. The Hunter Valley in New South Wales is being threatened by a rapid increase in coal mines and coal seam gas production. Dust from the coal mines can cause health problems in local populations and has tainted milk production to the extent that farm families have had to move to other areas (ABC, 2010). Lucrative offers by coal companies (including foreign companies) to buy land has also driven farmers to sell their properties. Concerns over the environmental and social impacts from proposed mining in prime agricultural areas are increasing, creating great uncertainty in regions such as the Liverpool plains of New South Wales and southern Queensland (Commonwealth of Australia, 2009).

In summary, conservation as a land use has taken over the largest area of agricultural land in Australia but with minimal impact on production. Urban sprawl around cities and regional towns has the greatest impact on agricultural productivity due to occupying land with better soils and climate, and increasing land values beyond agricultural returns. Intensive farms in peri-urban areas are often forced to move further away from their city consumers due to conflicts. Rural lifestyle properties can have more impact on lost production in terms of spatial area than urban residential lots but they have the potential to continue producing agricultural goods of higher value through intensification and production of niche commodities. Forestry posed a significant threat during the 1980s and 1990s but has been scaled back due to collapse of investment schemes, fears of reduced water supplies and bushfires and loss of rural communities. Mining is emerging as a growing threat to agricultural production in areas of high rainfall and good soils.

Social and demographic changes in agriculture

The 2008–09 agricultural survey showed there were 136,000 businesses undertaking agricultural activity (ABS, 2010a). This represents a significant decrease since 1975 when farmer numbers were 260,000. Exit rates from
farming were highest in the 1980s and 1990s due to falling wool prices and drought, but have since lowered to a rate of around 4.4% per year (Commonwealth of Australia, 2004). Younger farmers (25-34 years) and older farmers (65-80 years) have higher exit rates due to off farm education and work, or retirement respectively.

Likewise, the number of people entering farming declined from 1976 to 1986 and has now stabilised with a more even spread of ages entering farming due to the need for considerable capital to enter farming (Commonwealth of Australia, 2004; Commonwealth of Australia, 2009). The median farmer age has been steadily rising, from a low of 44 years in 1981 to a little over 50 in 2001 (Barr et al., 2005). This trend has continued with 35.8 per cent of farmers now over 55 years (PMSEIC, 2011). The high median age is expected to continue as shown in Figure 3.

![Figure 3 Median age of farmers between 1976 and 2006 and predicted age 2011 to 2031 (Commonwealth of Australia, 2004). Source PMSEIC, (2011)](image)

It is estimated there are 317,730 people directly employed on Australian farms and 1.6 million Australians employed in farming and food related industries such as processing, packaging, transport, food retailing, accommodation, cafes and restaurants (NFF, 2009). However, the lack of young, skilled and resourced people to work in agriculture and food industries is alarming. As the Agriculture and Food Policy Reference Group (2006, p103) reported, ‘the agriculture and food sector needs a workforce with the right skills and training to allow growth and improved productivity. Many agricultural employers are finding it difficult to recruit and retain both skilled and unskilled staff.’

The decline in employment in agriculture is not only due to declining rural populations and ageing of farmers, but also more capital intensive farming, greater competition for labour in other industries (eg mining), migration of young people to cities, widespread drought, and lack of graduates (DAFF, 2011a). In the tertiary sector, there have been declining enrolments in agricultural science courses raising concerns about the future availability of trained scientists and skilled farmers as shown in Figure 4 below (PMSEIC, 2011). With estimates that over 50 per cent of agricultural scientists are likely to retire in the next few
years, investment in workforce development and tertiary enrolment incentives is urgent. If Australia fails to attract its young people into agriculture, it may have to increasingly rely on migrant labour (DAFF, 2011a).

![Figure 4 Total graduate completions in agriculture from Australian universities for the period 2001-06.](Australian Council of Deans of Agriculture, 2009). Source PMSEIC 2011

Over 95 per cent of Australian farms are family owned and operated with family farms expected to remain the dominant business structure over the next few decades (Agriculture and Food Policy Reference Group, 2006). However, changes in ownership and management are occurring with more leasing and share farming arrangements underway (Commonwealth of Australia, 2009; Mendham and Curtis, 2010). Property turnover is predicted to increase by 50% in the next ten years in some areas, resulting in further fragmentation into lifestyle properties or amalgamation into larger properties (Mendham and Curtis, 2010). Foreign ownership and investment in agriculture in Australia are also increasing but there is no national database recording the location or extent of foreign ownership of land in Australia. Public concern has led to a parliamentary inquiry with an audit to be undertaken in 2011 (Commonwealth of Australia, 2009; DAFF 2011a).

In summary, Australia has lost almost 50% of its farmers in the last 30 years although this has not reduced overall agricultural production. Perhaps more alarming is the increasing average age of farmers and lack of young people entering agriculture as farmers, scientists and agribusiness personnel (Figures 5 and 6). Uncertainties around changing ownership of farms, available labour and investment in research and development are also creating concerns regarding future food production.
Environmental impacts and climate change

Since European settlement, widespread clearance of native vegetation for agriculture has caused land and water degradation, landscape fragmentation and loss of biodiversity across Australia (Aplin, 2002). Dryland salinity directly affects 2.5 million hectares, more than 12.5 million hectares of prime agricultural land in years when the water table rises with estimates of possible land affected by dryland salinity in 2050 at 17 million hectares (Poldy and Foran, 2002). More than 24 million hectares of soil is considered acidic causing production losses in excess of $134 million per year, and requiring expensive lime and fertiliser inputs. Irrigation salinity is also present in some regions with excess salt being carried into river systems (Poldy and Foran, 2002).

Australian soils are also deficient in phosphorus, potassium and nitrogen, needing regular fertiliser applications to maintain productive pastures and crops. Fertiliser subsidies were provided up until the 1970s to encourage spreading of superphosphate with subterranean clover on grazing land, and to boost crop production on rapidly expanding cropland. Since the cessation of subsidies, the cost of fertiliser (mostly imported) has become a major input expense for farmers along with the rising cost of fuel. According to DAFF (2011a), global reserves of phosphates that can be economically extracted will be available for the next 100 years. On the other hand, rising energy costs in processing fertiliser may push prices up in the long term, and require more research into fertiliser efficient plants (PMSEIC, 2010).

Water management has become a major issue in Australia in the last 20 years. According to DAFF (2011a), almost 70 per cent of Australia’s water is used for agriculture and food processing. The development of dams and irrigation infrastructure in the 1920s enabled agriculture to flourish in areas with highly variable rainfall. However, over allocation of water licences and successive droughts has had a devastating effect on ecological resources, particularly in the Murray Darling Basin, a 1,000,000 square kilometre area often described as the ‘food bowl’ of Australia. The amount of surface water diverted from the Murray and Darling River systems for use in towns, industry and irrigation increased from 2,000GL/year in 1920 to around 11,000GL/year in the 1990s
Together with prolonged drought in the 1980s and again in the last decade, the loss of water in the river systems has created rising salinity, blue-green algae outbreaks, red gum dieback, loss of native fish species and closing of the Murray River mouth (MDBA, 2010).

A water reform process was started in the 1990s to set limits to water use across the Basin and enable water trading between users (Nevill, 2009). The federal government is also buying back water licences in an effort to allocate more water to environmental flows. A new Basin Plan is being developed to return water to the environmental on a yearly basis and set limits on diversion of surface water and extraction of groundwater (MDBA, 2010). Controversy surrounds the Basin plan as farmers (particularly irrigators) and rural communities are worried about potential loss of production and associated social ramifications.

Climate change is predicted to impact on Australia in terms of a wetter and warmer climate in the north, and drier and warmer climate in the south. Increased frequency and severity of droughts, heat waves and natural disasters such as cyclones, fires and floods are also anticipated (IPCC, 2007). Many of these impacts are already happening. Drought has already reduced production from 2000 to 2009 (see Figure 1), and resulted in further environmental degradation and social disruption. Where there is a heavy reliance on irrigated agriculture, a negative flow-on effect to dependent businesses has occurred with loss of jobs and government services (Alston and Witney Soanes, 2008).

Bushfires in 1983, 2003, 2006 and 2009 burned significant areas of forest and farmland in southern Australia, resulting in loss of human lives, farm infrastructure and livestock (Erikson and Gill, 2010). Northern Australia has experienced two major cyclones in the last decade, devastating banana and sugarcane crops. Flood events in 2010 and 2011 disrupted agricultural businesses across most of eastern Australia causing crop damage, livestock and human deaths. The combined cost of recent cyclones and floods in the state of Queensland alone has been estimated at US$10 billion (ABR, 2011).

In summary, Australian agriculture and the country as a whole has thrived economically at the expense of natural systems and has relied on previously cheap inputs. The environmental costs of water and nutrient extraction, and loss of biodiversity have never been fully accounted.

Discussion

In this discussion we return to the question, “can and should Australia continue to export food and feed itself in the face of changes in use and ownership of agricultural land, tighter water regulations, increasing input costs, declining numbers of farmers and rural labour, environmental degradation and a changing climate?” Firstly we address whether Australia can produce enough food for future domestic and export uses. Then we discuss whether Australia should take action to maintain, decrease or increase agricultural production given environmental concerns, economic competition and social equity issues.
Given current and short term projections of agricultural production in Australia, there does not appear to be any adverse impact of loss of agricultural land area on the quantity or value of agricultural production. Similarly, despite the significant decrease in the number of farmers, remaining farmers are continuing to produce more with less land even with decreasing terms of trade and minimal government payments (Malcolm, 2009; NFF, 2009). Improved technologies from agricultural research, access to inputs and strong market demand have kept agricultural industries competitive (NFF, 2009). Off farm income has also helped farm families to survive (Barr, 2003; Alston and Witney-Soanes, 2008). The ability of Australian agriculture and farmers to adapt to change, and the competitive nature of export trade gives a level of confidence in Australia’s capacity to produce food in the future (Poldy and Foran, 2002; PMSEIC, 2010; DAFF, 2011a).

Will this change in the long term? Australia’s population is projected to grow from 22.5 million people to around 35 million people in 2050 (Commonwealth of Australia, 2010). If agricultural land continues to be lost at the current rate of 5.9 million ha per year (to conservation, urban growth, lifestyle subdivisions, alternative energy sources and mining) then available agricultural land will decrease from 18 to 5 hectares per person by 2050. The major concerns for Australia emerging from loss of agricultural land are; 1) reduction in food production from productive areas close to coastal cities and regional towns due to lack of controls over urban growth; 2) slowing of agricultural production from amenity areas due to an ageing population and further subdivision into hobby farms; 3) land use conflicts in peri-urban areas and adjacent to mines; and 4) loss of productivity in areas with reduced water availability. The extent this reduction in available farmland may impact on food production depends on where the loss occurs (eg fertile areas or extensive pastoral areas), availability and cost of inputs (eg water, nutrients, energy, labour) and the socio-economics of production (eg loss of communities, young people, skilled labour, markets).

Regional variation is significant in this regard, with amenity areas predicted to continue to be influenced by the older, non-farming community, whereas irrigated horticulture and broadacre cropping regions will continue to attract younger full time farmers. Remote non-irrigated areas may continue to de-populate as farms are aggregated, leased or managed from afar. Those areas in between (eg open grazed hill country) which rely on off farm income in conjunction with beef production will continue to hold out until purchased by in-migrants (Commonwealth of Australia, 2004).

Australia may be able to continue to feed itself and export major commodities from less farmland through intensification, diversification, new technologies and importing labour from Asia and the Pacific. For example, Bastin (2008, p.163) reports that rangelands (81% of Australia’s landmass and occurring mostly in inland Australia) have increased in land value by 150 to 300% in the last 10 years due to sound livestock markets and prices; diversification into horticulture and cropping; the demand for conservation properties and the ‘ripple’ effect of rising land prices elsewhere. Holmes (2006) also describes inland areas that have undergone multifunctional rural transition from marginalised pastoralism to
diverse uses based on the reordering of consumptive, production and protection values in rural landscapes.

However, future food production holds some uncertainty due to predicted impacts of climate change, rising energy and fertiliser costs and decline in research investment (Commonwealth of Australia, 2009). These impacts may render some regions unable to economically produce food or support rural populations. In Australia, irrigation areas are already being scaled back due to over-allocation of water licences, droughts and the need to restore environmental flows in degraded rivers (Smith, 2003). The social impacts of future droughts in south east Australia may continue to be profound (Alston and Witney-Soanes, 2008).

Recent government investments in developing land and water management plans and water infrastructure have increased water use efficiency for irrigated pastures and cropping, but in some years there may not be a return on investment due to lack of water entitlements, not enough land and variable commodity markets (as has occurred already with fruit production and dairy in northern Victoria) (MDBA, 2010). Inland farms may continue to get larger with leasing and management arrangements geared to arranged contracts for low input commodities. A reduction in productive farming in marginal inland areas or increased transport costs may force intensive farming back into coastal areas to produce more on smaller areas near urban centres, which may lead to further land use conflicts.

According to Poldy and Foran (2002), under a population scenario of 35 million by 2050, domestic consumption may reduce the amount available for trade and international trade balances may be affected. Almost a decade later, DAFF (2011a, p viii) are also predicting that as the population increases, imports are likely to complement domestic production to fulfil Australia’s food requirements, especially processed foods. Trade offs are already occurring between domestic and export production with increased food imports and reduced exports due to variability in exchange rates, as shown in Figure 1.

Others argue that such faith in global competition, economic forces and government capacity to intervene is risky, and that food systems need to be more robust, energy and resource efficient, affordable and community driven (Booth and Smith, 2001; Campbell, 2009; Sumner et al., 2010; Mason and Knowd, 2010). Environmental and ethical considerations regarding land use, food production and food security are also brought into the question of whether Australia should take action to maintain, decrease or increase agricultural production (Gray and Lawrence, 2000; Hamblin, 2009; Nevill, 2009; Millar, 2010). Should Australia be more protective of its productive land, farmers and consumers in terms of access to nutritious and affordable food?

These issues around food security are slowly gaining traction in Australia amongst government and NGO networks. There have been calls for a national food security agency and strategy (PMSEIC, 2010; SBS 2010), national population debates (Commonwealth of Australia, 2010), a Victorian future farms initiative (DPCD, 2010), and policy propositions for sustaining food and farming
systems in the state of Victoria (Campbell, 2009). A Senate Select Committee to look at food production in Australia (Commonwealth of Australia, 2009, p14) concluded that,

‘From Australia’s perspective, it is imperative that we maintain a productive base capable of meeting the food needs of the domestic population to ensure food security in the event that other countries become unwilling to trade food grown within their borders. Even more important, however, is the need for Australia, as a major food exporter, to contribute to meeting the global food task and thereby prevent the potentially disastrous consequences of major food shortages.’

The recent release of an issues paper for a national food plan acknowledges community concerns over loss of productive agricultural land, foreign ownership, mining exploration, water use and food attributes (DAFF, 2011a). However, as yet there is no clear plan of action to deal with these issues. Regarding land use, several authors conclude that traditional land-use planning schemes in Australia have not coped with rapid demographic change in rural areas, particularly in regions with net in-migration (Bunker and Houston 2003, Buxton et al. 2006; Millar 2010). Furthermore, Budge and Slade (2009) maintain that the links between land use planning and food security are poorly understood in Australia.

Land use planning in Australia is the responsibility of state, territory and local governments. Some states have attempted to protect peri-urban areas from residential development using green belts and farming zones (Millar, 2010). The state of Queensland is about to introduce legislation to minimise impacts of mineral extraction on strategic cropping land (DERM, 2011). However, these initiatives are reactive attempts to slow the bolting horse, instead of taking strategic action to plan for future food production. The national government, in the meantime sits on the fence giving encouragement to state governments to protect productive land with statements such as, ‘Given the juxtaposition of arable land and urban population centres, it would be prudent to integrate food production as part of metropolitan land and development strategies.’ (PMSEIC, 2010, p.41).

A more proactive approach is needed to quarantine productive areas for future food production by all levels of government. The suggestion of developing a National Land Use Planning Framework to secure future food production, reduce ‘food miles’ and transport costs, and engage communities could be a step to achieving genuine protection (PMSEIC 2010). However, such a framework would have to guide and influence national and state legislation to moderate urban sprawl, foreign ownership, mining interests, water use and other land use threats to food security. At the same time, incentives are required to facilitate capacity building of a future agricultural workforce and generate environmentally sound technologies for future food production.
Conclusion

Over the last century, Australia has developed an economically competitive agricultural sector that has met the food requirements of a growing nation and increasing export demands from overseas countries. Australian agriculture has relied on extensive land and water resources, a willing workforce and sound investment in research and development. However, there are signs that productivity growth is slowing, agricultural land is converting to other uses, farmers are ageing and exiting the industry, water has become a contested resource, biodiversity is suffering and land conflicts are emerging.

Despite these threats, predictions are that in the short term at least, Australia can continue to export food and produce enough domestic food, give or take minor import substitutions at times. Longer term food security for Australia and its trade partners is less certain due to ongoing climate change impacts, loss of productive land to urban sprawl and mining interests, loss of skilled labour and underinvestment in research and development. Ethical questions of whether Australia should be maintaining agricultural production at the expense of environmental degradation or to support declining rural communities are also problematic. Choices will need to be made regarding protection of productive land, use of surface and groundwater, biodiversity protection, investment in new technologies to adapt to climate change, and incentives to lure young people into a new age of agriculture.

Food security debates are underway and a national strategy is planned in the coming years. A major challenge is to engage urban and rural communities in decision making regarding the future of Australian agriculture. National, state and local governments will need to work together to keep the most productive land for agriculture using regulatory and market based mechanisms, and economic incentives to enable producers to compete with alternate land uses. Such approaches may not be politically palatable in the Australian context but the alternative may see Australia becoming a net importer of food with the associated economic, biosecurity and health risks.
References


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