FOOD SECURITY PLAN FOR WESTERN AUSTRALIA:

Situation report to guide the strategic development of a food security plan for Western Australia.

September 2019

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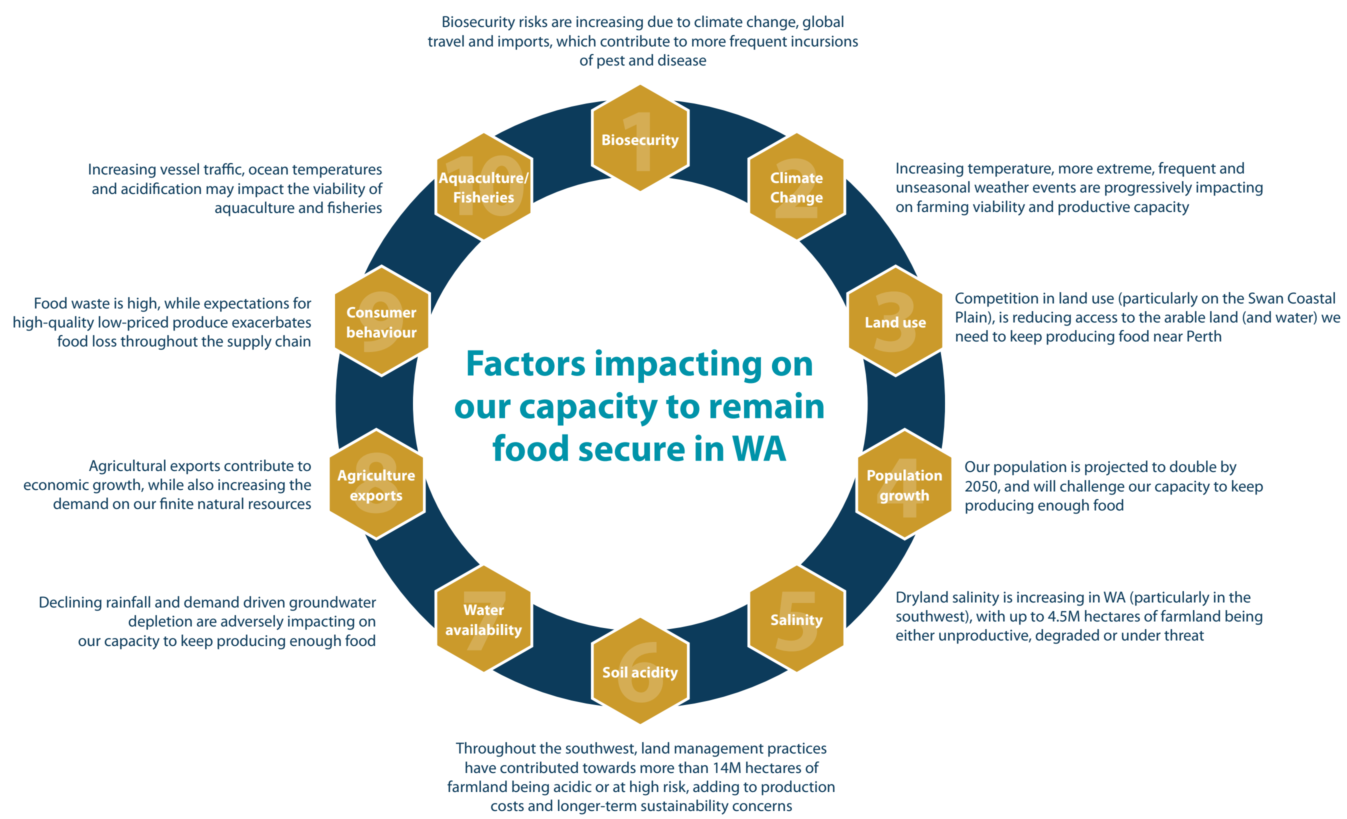
Australian Government | National Landcare Program | Perth NRM | foodfuture WA | Curtin University

01 Introduction

Food security is critical to the world. In fact, global population is expected to increase to around 9.6 billion people by 2050[1]. Combined with the increased consumption of calories and more complex foods, which accompanies income growth in much of the developing world, estimates suggest that agricultural production will need to expand 60% (compared to 2005/2007 levels) by 2050, placing substantial stress on food security[2]. For example, cereal production will need to increase by nearly 1 billion tonnes and meat production by almost 200 million tonnes[3]. Closer to home, in Western Australia (WA), the population is expected to double by 2050[4]. To meet our demand, enabling a future food supply becomes a strategic priority.

While there are many factors affecting food security, research suggests that ten factors are among the most prominent (Figure 1). As noted, population growth is one key factor; however, there are others including biosecurity, climate change, land use, salinity, soil acidity, water availability and agricultural exports. Demonstrated in Figure 1, each of these factors are expected to have some level of impact on food security. Based on the best and most recent data and research available, this report will delve deeper into each one, providing a context for further insight.

'Figure 1. Factors effecting WA food security'.



02 Factors effecting food production and security in WA

In the context of this report, food security is the ability of individuals, households and communities to acquire appropriate and nutritious foods on a regular basis[5]. In this sense, food production capacity is key. Currently, Australia produces enough food to feed the domestic population. Further, Australian food production and agricultural research and expertise is believed to contribute to the diets of up to 400 million people, with the greatest proportion in Asia[6]. While these are encouraging facts, future headwinds could impact the extent to which food security is achieved in the nation and Australia's contribution to global demands. Specifically, this report outlines impacting factors and describes potential effects on food security in WA. The factors and their interrelationships are complex, and this report provides foundational knowledge to inform future food security planning in WA.

1. Biosecurity

WA is advantaged by geographic isolation, which provides a natural advantage for biosecurity (i.e. animal, plant and aquatic pests and diseases) protection. However, the 12,500km of mainland coastline (almost 21,000km counting offshore islands) presents significant challenges and numerous points of entry for biosecurity risks to be introduced. While WA is currently free from a large number of pests, diseases and weeds that are found in many parts of the world because of isolation and a robust biosecurity system, without continued diligence, agricultural production and food security will be threatened. In fact, as a country of urban dwellers, Australians are increasingly disconnected from biosecurity issues[7]. At the same time, urban encroachment and peri-urbanisation (i.e. dispersive urban growth creating hybrid landscapes of fragmented and rural characteristics) continue to create new biosecurity challenges[8]. Further, globalisation, migration, increased traffic from tourism and products entering WA borders from around the world increase threats to biosecurity (Figure 2)[9].

In practical terms, a small outbreak of foot-and-mouth disease could cost the cattle industry around $10 billion in revenue losses over a 10-year period, while a large multi-state outbreak could result in revenue losses of up to $51 billion[10]. More broadly, based on ABARES modelling, estimated losses from incursion of pests, diseases and weeds across a variety of agricultural products are demonstrated in Table 1 and Figure 3[11].

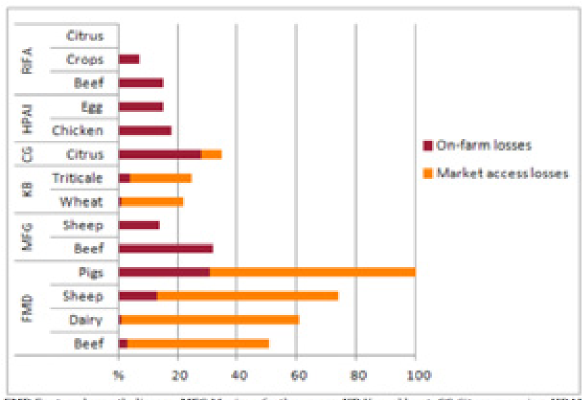
Figure 2. Examples of pathways that present biosecurity risks

Table 1. Farm gate value of biosecurity at the enterprise level ($/hectare)[a]

Performance measure		FMD[d]				MFG[e]		KB[f]		CG[g]	HPAI[h]		RIFA[i]		
	Units	Beef	Dairy	Sheep	Pigs	Beef	Sheep	Wheat	Triticale	Citrus	Chicken	Egg	Beef	Crops	Citrus
Losses caused by pest, disease or weed															
Market access loss	$	58	800	141	928	0	0	109	38	294	0	0	0	0	0
On-farm losses and expenditure	$	4	10	31	81	30	33	7	7	1 245	25 287	43 316	17	24	17
Total losses	$	62	810	172	1 009	30	33	116	45	1 539	25 287	43 316	17	24	17
Enterprise gross margin before and after an incursion															
Gross margin before an incursion (1)	$	119	1 329	230	261	94	230	513	180	4 509	136 289	308 369	119	346	4 509
Gross margin after an incursion (2)	$	58	520	58	–748[j]	64	197	397	134	2 970	111 002	265 053	102	322	4 492
Expected enterprise gross margin															
With biosecurity[b]	$	119	1 321	228	259	89	224	512	179	4 494	136 038	307 940	118	344	4 507
Without biosecurity[c]	$	109	1 197	202	218	85	220	478	166	4 257	132 148	301 276	113	338	4 503
Contribution of biosecurity to annual farm enterprise profits ($)	$	10	125	26	40	4	5	34	13	237	3 890	6 664	5	6	4
Contribution of biosecurity to annual farm enterprise profits (%)	%	8	9	12	15	4	2	7	7	5	3	2	4	2	1

a For all enterprises except chicken, eggs and pigs, gross margins are estimated in $ a hectare. For chicken and egg enterprises, gross margins are estimated in $ a farm. For pig enterprises, gross margins are estimated in $ a sow.

Figure 3. Reduction in annual farm enterprise profits after incursion (%)



FMD Foot-and-mouth disease. **MFG** Mexican feather grass. **KB** Karnal bunt. **CG** Citrus greening. **HPAI** Highly pathogenic avian influenza. **RIFA** red imported fire ant.
Note: Estimated reduction in the annual profit of pig enterprises following an FMD incursion is 387 per cent. However, farmers are assumed to stop production when it is no longer profitable.

Currently, biosecurity systems such as boarder quarantine checkpoints, intrastate regulatory controls and surveillance programs are working to maintain WA's safe, high-quality agricultural products. However, as risk continues to be introduced (Figure 2), biosecurity efforts must remain forthright and diligent to ensure food security into the future.

2. Climate change

Climate change has been a fixture in the scientific community, government and public spheres for decades. Recent data suggests that in Australia, the warmest years on record occurred in the last 10 years[12]. In WA, average temperature has increased by 1ºC over the last century (and particularly the last 50 years), while rainfall has decreased by 20% over the southwest[13]. A changing climate is an important factor impacting food security in WA.

In 2016 the WA agricultural sector was set a goal of doubling in value by 2025[14]. While changes in climate are not expected to impede short-term food security, future forecasts are more challenging. For example, by 2030, the average temperature is projected to be up to 1.3ºC warmer in WA, and by 2100, up to 5.1ºC warmer (compared to 1986–2005 averages) (Figures 4 & 5)[15].

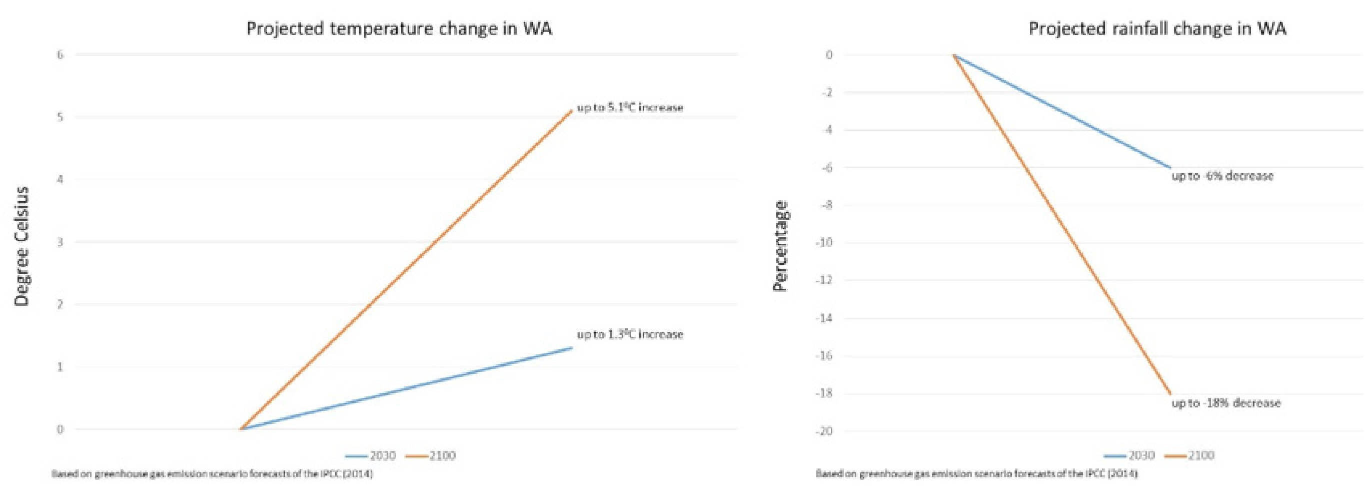
By 2030, rainfall is expected to decrease by up to 6% across the state and by 2100 decrease by up to 18% across the state (compared to 1986–2005 averages) (Figures 4 & 5)[16]. Failing rainfall impedes winter irrigation and also has negative effect on groundwater recharge. Lower volume of rain means less water reaches the aquifers through saturation of the soil.

In addition to temperature and rainfall changes, extreme weather is expected to increase. For example, in metro Perth, the number of extreme heat days (i.e. number of days in a year with maxima over 35ºC) is predicted to increase from 28 (1971–2000 average) to 36 in 2030 and by up to 63 by 2090[17]. Additionally, drought conditions are expected to increase by up to 20% across Australia by 2030 and in the southwest of WA by up to 80% by 2070[18]. Other research suggests that drought will effect twice as much of southern WA and/or twice as often by 2030[19].

To put these figures into perspective, under climate change, forage production (e.g. grasses, legumes) for pasture and livestock productivity may be reduced by up to 10% over agricultural areas and southern rangelands and by 10-20% over the rest of the state. With respect to wheat production (WA's largest agriculture product by value), yields have been found to decline by 0.53% for every 1% decline in rainfall, while declining by 4.9% for every 1ºC increase in temperature[21].

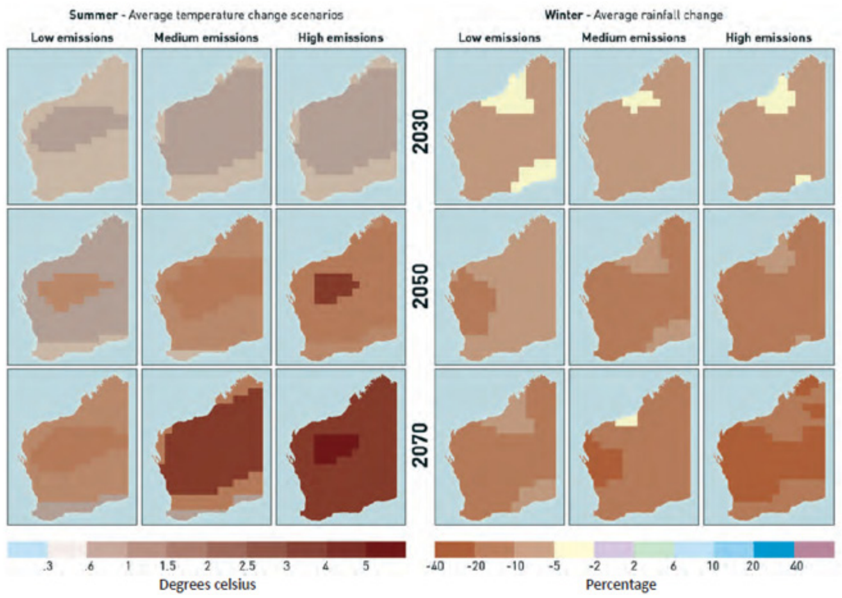
Combining forecasted changes in temperature and rainfall with projected increases in more extreme heat days and the increased duration and frequency of drought, as well as potential productivity declines, food security in WA could be challenged into the future[22].

Figure 4. Annual temperature and rainfall changes for WA, 2030 and 2100[1]



[1] Note that in a recent greenhouse gas inventory report, overall, total Australian emissions decreased by 12.7% from 2005 to 2017. However, in WA, greenhouse gas emissions have increased more than 23% since 2005. See http://www.environment.gov.au/system/files/resources/917a98ab-85cd-45e4-ae7a-bcd1b914cfb2/files/state-territory-inventories-2017.pdf

Figure 5. WA climate change scenarios 2030 to 2070 (summer and winter scenarios only)



3. Land use and productivity

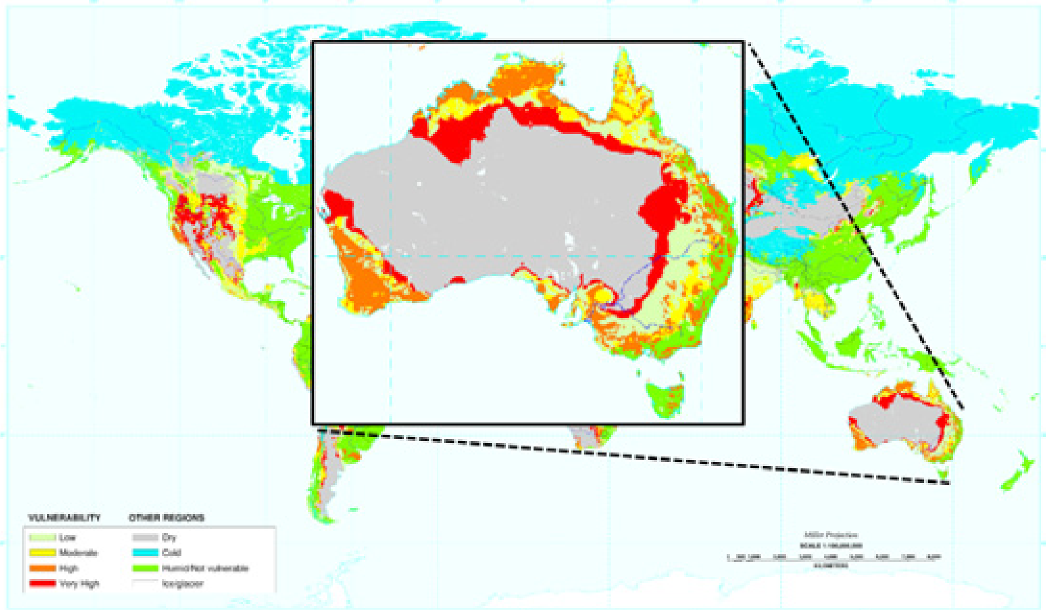
Since the 1960s, the agricultural land area around the globe has halved—from approximately 1.5 hectares per person to less than 0.8 hectares per person[23]. Future estimates, by the Food and Agriculture Organisation (FAO) of the United Nations, suggest that only a limited amount—5% to 10%—of net surface area of agricultural land can be added by 2050 (mainly in Africa and South America)[24].

Regarding productivity of the land, the combined global yield of corn, rice and wheat (over two-thirds of the world's food) tripled during the past 50 years, while harvested areas increased by only around 30%[25]. With respect to total factor productivity, agriculture has been up 1.5 percentage points higher than in non-agriculture, but the pace has slowed during the more recent decades due to insufficient investments[26].

Australia's rising and increasingly urbanised population combined with economic growth puts pressure on the sustainability of our environment. Only 3% of Australia's 761 million hectares of land available for agriculture is currently used for cropping and horticulture. This is mainly because of highly variable and low annual rainfall over much of the continent and limited access to water for irrigation in many regions. New areas of land, such as northern WA, could be farmed if there was substantial public investment in irrigation, energy and transport as well as in new technology and skills[27].

Perhaps one of the biggest challenges for the agriculture sector, with respect to future production and productivity, is arable land affected by desertification. Desertification refers to the persistent degradation of dryland ecosystems. Across Australia (including WA), there are vast areas that have a high to very high vulnerability to desertification (Figure 6)[28]. As desertification increases, arable land for agriculture declines. Desertification is believed to be caused by a number of factors, including overgrazing, deforestation, certain farming practices, population growth, urbanisation, fragmentation of rural land holdings and changing natural environmental conditions (e.g. climate change); hence, the availability of arable land is believed to be under pressure, challenging a food secure future[29].

Figure 6. Global desertification vulnerability



4. Population growth

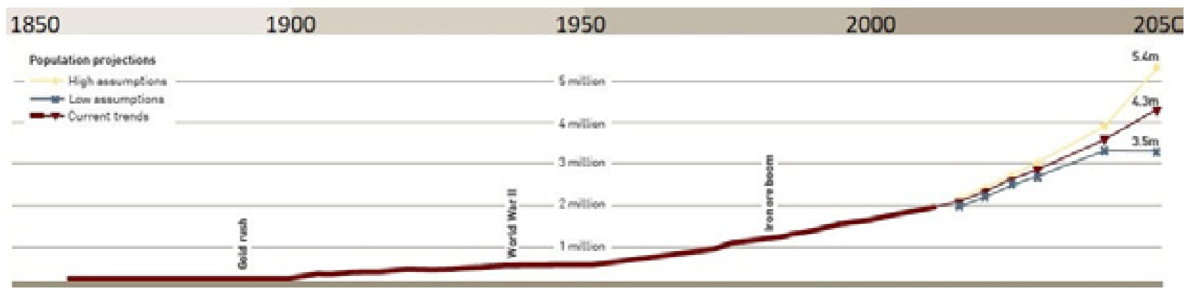
Since 1961, the WA population has seen steady growth. Much of this growth has been attributed to migration, both overseas and interstate[30]. While Greater Perth has been the largest beneficiary of migration, regional centres such as the Pilbara, Peel and Kimberly have also shown marked rates of growth[31].

Future projections suggest that the WA population is expected to increase to 5.4 million by 2050, and as high as 5.6 million by 2056 (Figure 7)[32]. That means an additional 2.9 million people residing in the state.

Increasing numbers of people drive up the demand for food, which can result in the additional use of arable land and water. Paradoxically, as the population grows the need for housing—and land for housing—increases. For example, in Greater Perth alone, an expected 800,000 additional homes will be required to satisfy population growth by 2050[33].

With respect to feeding the people of WA, as a benchmark, studies suggest that a population growth of 2-3% per year requires an annual increase of 3-5% in agricultural production levels[34]. Given that the WA population is predicted to double by 2050, and combined with factors such as climate change and groundwater depletion, future food security is expected to be affected.

Figure 7. WA historical and projected population growth



5. Salinity

Water quality is essential to agricultural production, particularly for production requiring water supplies. Water moves into plant roots by a process known as osmosis, which is controlled by the level of salts in the soil water and in the water contained in the plant. In the case where the levels of salts in the soil water is too high, water may flow from the plant roots back into the soil. Water flowing from plant roots back into the soil results in dehydration of the plant, causing yield decline or even death of the plant. Crop yield losses may occur even though the effects of salinity may not be obvious. The salt tolerance of a specific crop depends on its ability to extract water from salinised soils. Salinity affects production in crops, pastures and trees by interfering with nitrogen uptake, reducing growth and stopping plant reproduction.

At a broad level, the national picture reveals that many locations have reached groundwater levels of salinity greater than 1,500mg/L, which is the salinity threshold for irrigation of most crops (Figure 8)[35] In the case of WA, groundwater salinity is not a new issue. For example, in 1955, approximately 73,000ha in the southwest of WA were affected by salinity (Figure 9)[36]. The most recent data suggests that more than 1 million hectares in the southwest are severely affected by salinity (Figure 9)[37]. A further 2.8-4.5 million hectares of highly productive, low-lying or valley soils is threatened by salinity[38]. The net impact suggests that from a risk perspective, in the southwest agricultural region of WA, 82% of the region has moderate salinity risk, 10% has a high risk and 8% has a low risk (Figure 10)[39]. Of note, this includes critical areas in the Wheatbelt and the areas with the highest dryland salinity risk are in the highly productive dryland agricultural areas[40]. Further, the estimated average annual value of lost agricultural production from dryland salinity in the southwest of WA is $519 million (OAG, 2018)[41]. Such loses would be expected to affect future food security.

Figure 8. National view of groundwater salinity

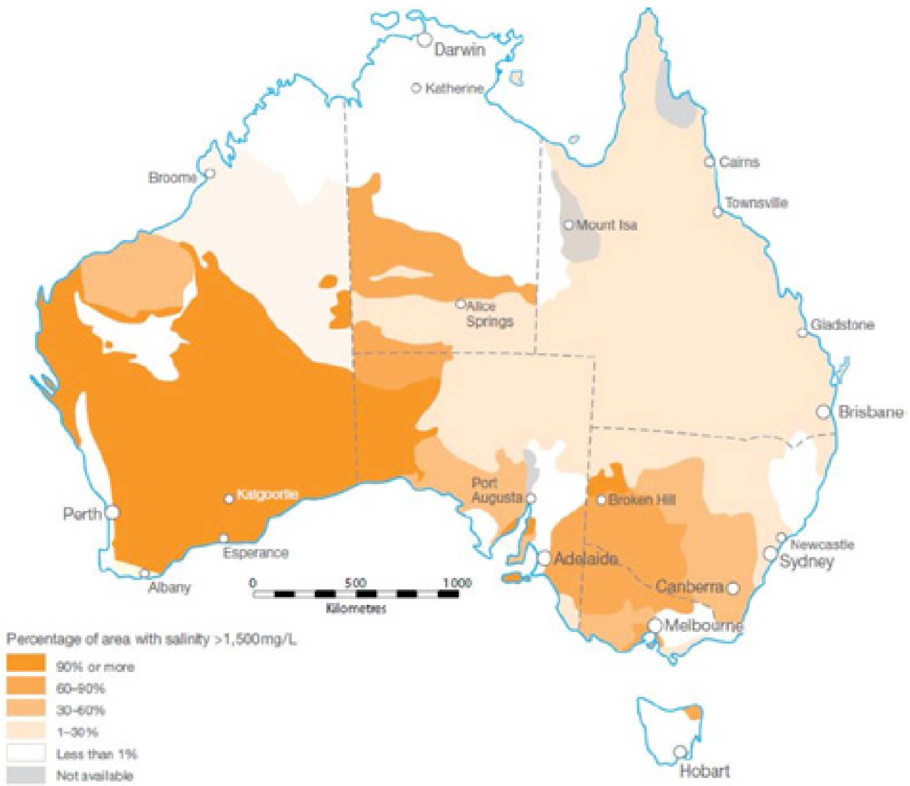


Figure 9. WA area effected by dryland salinity from 1955 to 2001

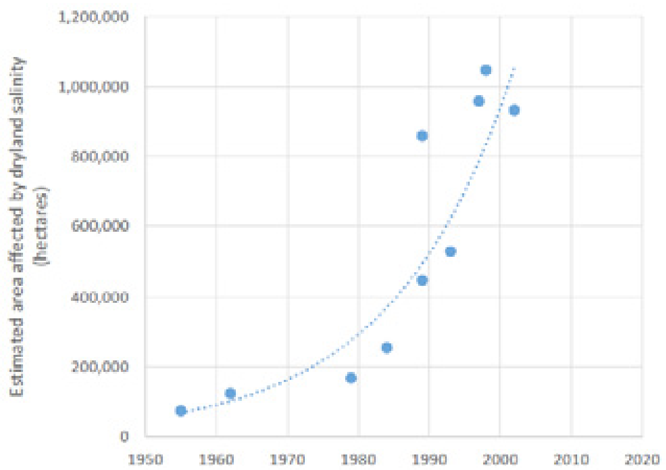
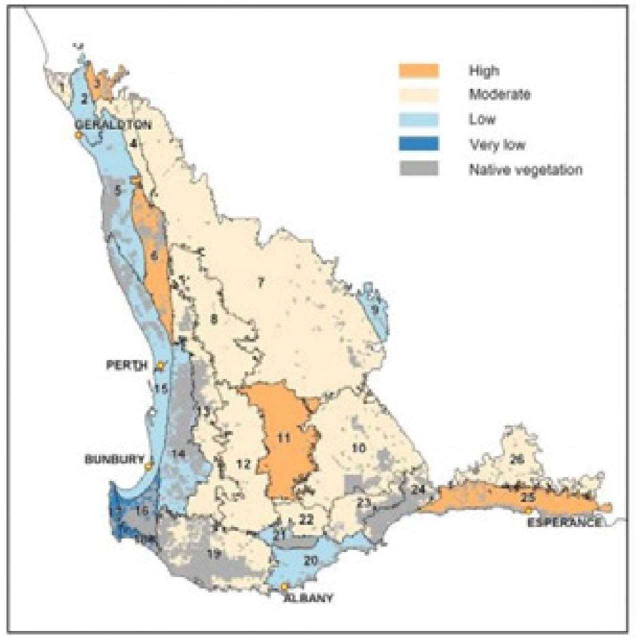


Figure 10. Dryland salinity risk in WA



6. Soil acidity

Similar to salinity, soil acidity can have detrimental effects on agriculture production and food security. While soil acidification occurs naturally over time as the soil is weathered, the process can be accelerated by more intensive and productive farming systems. The downside is soil acidity reduces the land's ability to provide clean air and water and productive soils, protect biodiversity and maintain the resilience of the landscape to climate change, whilst producing food and fibre.

Across Australia, estimates suggest that about half of agricultural land has a surface soil pH of less than or equal to 5.5, which is below optimum for extremely acid-sensitive agricultural crops, and below the optimal level to prevent subsoil acidification[42]. When soil pH falls below 5.5 for crops and 5.0 for pastures, productivity starts to decline. For example, plants sensitive to acidity (e.g. barley, beans, canola, peas, medics, wheat) have shown reduced yields of greater than 30% on soils with a pH in the 4.5-5.0 region[43].

With respect to WA, estimates place 84% of cropping land at high risk of soil acidification, 8% at moderate risk and 8% at low risk (see Table 2 and Figure 11)[44].

Table 2. Estimated percentage of cropping area risk of soil acidification WA

Region	Low risk (%)	Moderate risk (%)	High risk (%)
Avon	8	8	84
Northern Agricultural	2	7	91
Rangelands	74	6	20
South Coast	18	12	70
South West	5	7	88
Swan	0	12	87
Total	8	8	84

There is evidence to suggest that practices such as reduced tillage and increasing crop residue retention are occurring, which could be expected to reduce the risk of soil loss through wind and water erosion and increase soil carbon[45]. However, increasing acidification across much of Western Australia's cropping areas remains a significant risk. With more than 92% of all cropland in Western Australia at moderate to high risk of acidification, food security becomes an issue.

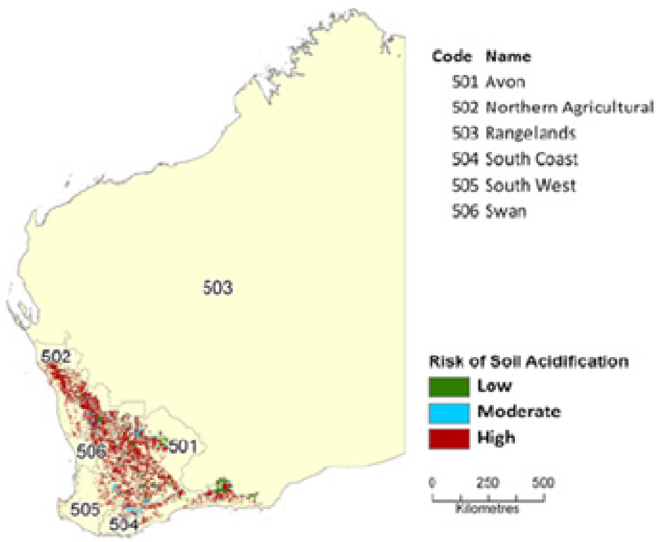
7. Water availability

Globally, on average, 70% percent of the fresh water withdrawn from rivers and groundwater is used to produce food and other agricultural products[46]. Historically, water use for agriculture in WA is less than the global average, around 50% versus 70% (and versus 60% for the rest of Australia)[47]. Currently, the percentage is even lower: around 33%—as water use for the mining industry has increased[48].

To generate agricultural production in WA, farmers generally use bores and irrigation infrastructure for their water needs. A large proportion of groundwater is licenced from shallow aquifers beneath the Swan Coastal Plain between Gingin and Busselton. The security and high reliability of the water supply from this low-cost water source is vital for WA's agricultural industries to supply fresh food to local and export markets. However, groundwater depletion can cause production and yields to decrease. Believed to be closely connected with climate change, groundwater depletion is occurring in WA[49].

First, rainfall is decreasing. For example, in the south-west region of WA (including the Wheatbelt), May–July rainfall has reduced by around 19% since 1970. Further, most global climate models predict that the region's rainfall will decrease by an average of 25% under the driest scenario at 2050 and 4% under the wettest scenario (Figure 12)[50].

Figure 11. WA cropping areas with low, moderate and high risks of soil acidification



Second, as rainfall decreases, streamflow decreases. As demonstrated in Figure 13, streamflows have decreased, effecting dam capacity and water availability. Particularly of note is the more recent decade, where rainfall has decreased fairly rapidly, resulting in a 50% reduction in streamflows relative to the 2001–2009 average. Simply put, if current trends continue and future projections are actualised (see climate change section), the availability of water supply from dams is likely to become problematic, resulting in the need for alternative water sources (Figure 14)[51].

Figure 12. Predicted rainfall decreases in south-west WA

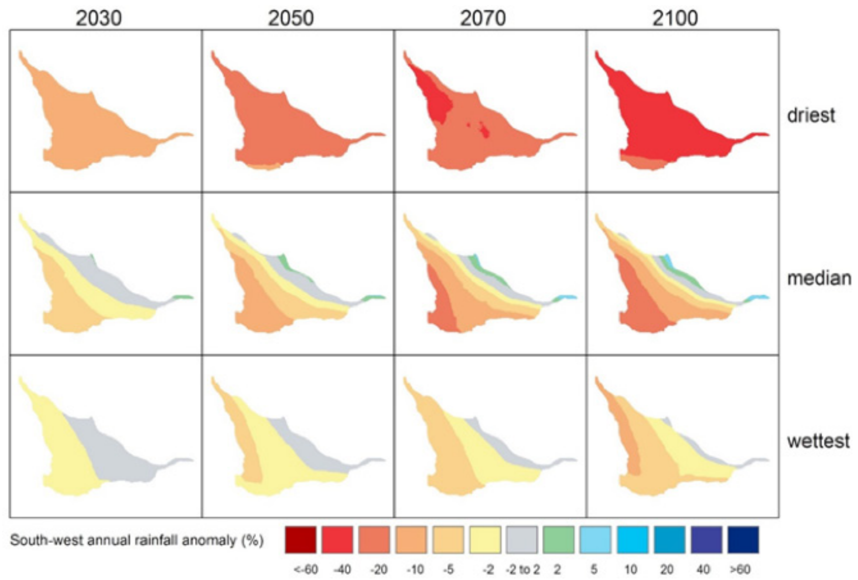
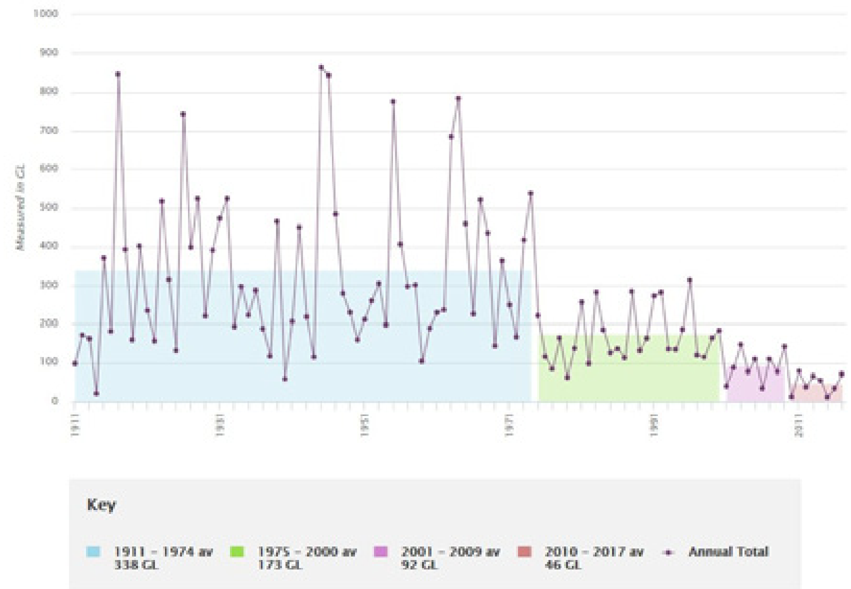
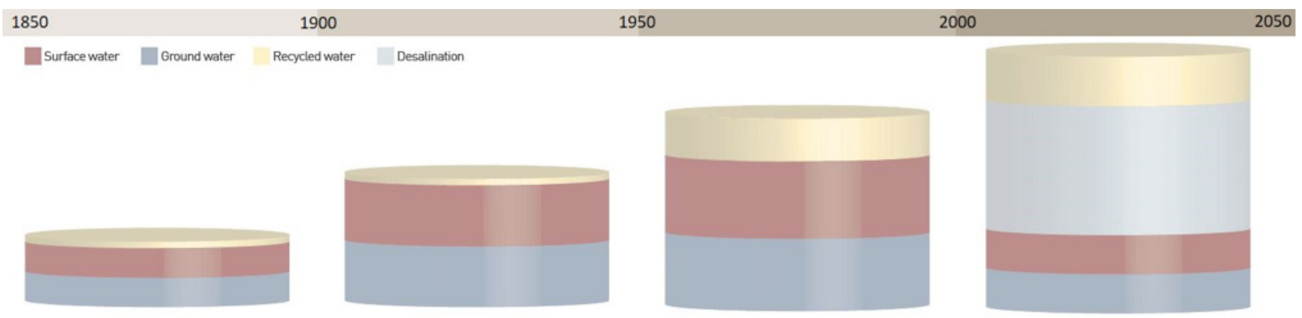


Figure 13. Historical streamflow in WA dams 1911 to 2017



Note: In order to provide an accurate historical comparison streamflow from Stirling and Samson Brook Dams are not included in this data as these dams only came online in 2001. Inflow is therefore modelled on Perth dams pre-2001.

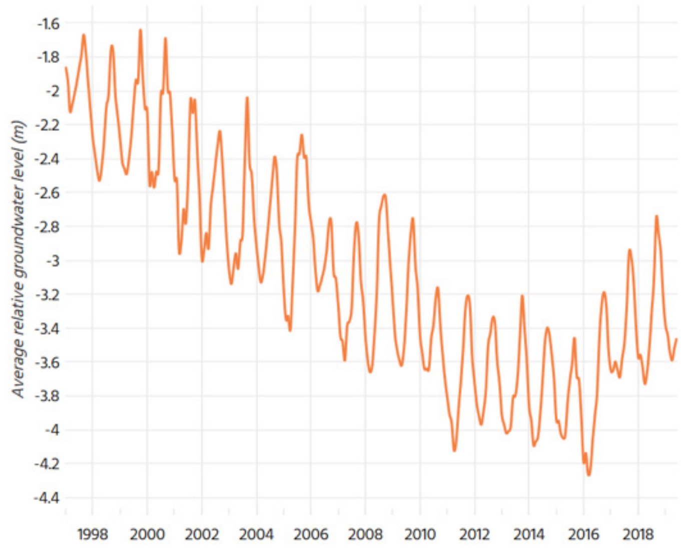
Figure 14. WA water sources (past and projected)



Third, winter rains in WA recharge groundwater. However, groundwater across the state has been in decline since the 1970s, largely due to less rainfall and streamflow. Recently, in 2016–2017, the Department of Water and Environmental Regulation reports that in 16 out of 30 representative wetland and vegetation sites, water levels were lower than criteria levels set by the Minister for the Environment[52]. Further, at the Gnangara Mound north of Perth, groundwater levels have generally been in decline for the last 40 years, largely due to decreased rainfall, increased water use and limited recharge (although in some areas, the rate of groundwater level decline has slowed and stabilised—see Figure 15)[53].

Taken together, decreased rainfall (both current and projected), declining streamflow and groundwater depletion place stress on access to water. Given that around one third of WA's water is used for agricultural production, food security in the future could be challenging.

Figure 15. Average groundwater levels of the Gnangara Mound



8. Agriculture exports

WA's agricultural sector contributes nearly $9 billion to the local economy, with 80% of the state's agricultural production destined for export markets (the majority of exports are destined for Asia)[54]. Further, agricultural production is vital to rural and regional communities and is a significant source of jobs, employing around 190,000 people[55]. Growth in the sector is a logical expectation.

For export growth to be realised, sustained investment in innovation and technology is required. Investment is particularly warranted in light of rising input and machinery costs (e.g. between 2013 and 2018, fertiliser costs rose by 5.7%, while machinery costs rose by 13.4%)[56]. The requirement for investment is exacerbated by other factors, including many outlined in this report. For example, some experts suggest that climate change, including warmer temperatures, less rainfall and extreme weather (droughts, extreme heat days) are the agriculture sector's biggest challenge[57]. Factoring in these potentialities, if export growth is to contribute to WA's economy, combined with feeding a population expected to double by 2050, then food secure solutions are required.

9. Consumer behaviour

Per capita, Australians are among the world leaders in food waste. For example, 35% of the average household rubbish bin is food waste, while over 5 million tonnes of food waste end up in landfill every year[58]. The Australian government estimates that, overall, $20 billion is lost to the economy due to food waste[59]. Further, nearly 8 million tonnes of greenhouse gases are emitted from landfill food waste, contributing to changes in climate[60].

Consumer expectations appear to represent a paradox. While Australians are fortunate to enjoy high quality food produced by the nation's farmers, considerable food waste occurs because of expectations perhaps being 'too high'. In one case, up to 40% of fruit and vegetables are rejected simply because of high cosmetic standards from consumers (and supermarkets)[61]. Alternatively, milk consumption, for example, is steadily increasing in WA[62]. Yet, consumer expectations for low price (but high quality), combined with the buying power of food retailers, places considerable pressure on the profitability of dairy farmers. Investment in production is believed to be constrained, which otherwise could potentially allow WA to be self-sufficient in dairy[63]. Consumer behaviour in the context of producer and supply chain issues are indeed complex, nevertheless, require thoughtful consideration in light of food security.

10. Aquaculture and fisheries

Recent data demonstrate that the volume of WA's commercial fishing (including aquaculture) in 2016/17 was 23,818 tonnes, with a gross value of $620 million[64]. While volume exceeded expectations and value increased by 5%, there are concerns. Of particular contemporary concern to WA's aquaculture and fisheries industries is the impact of increased marine noise, particularly in the Pilbara region on the distribution and behaviour of target species. While these concerns focus primarily on the impact of seismic noise profiles associated with oil and gas exploration and development, they also include general noise associated with increasing vessel traffic, fixed and floating production infrastructure and subsea infrastructure[65].

In the longer term, climate change will result in changes to the WA marine environment, such as increased ocean temperature and acidification. This will affect the habitats of commercial species and in some cases, the species themselves. For example, changes in water temperature, may see some tropical species move further south and ocean acidification may increase or decrease the growth rates of invertebrate species. Understanding the impact of these phenomena on the nature and viability of fisheries in the future will assist in investment decisions[66].

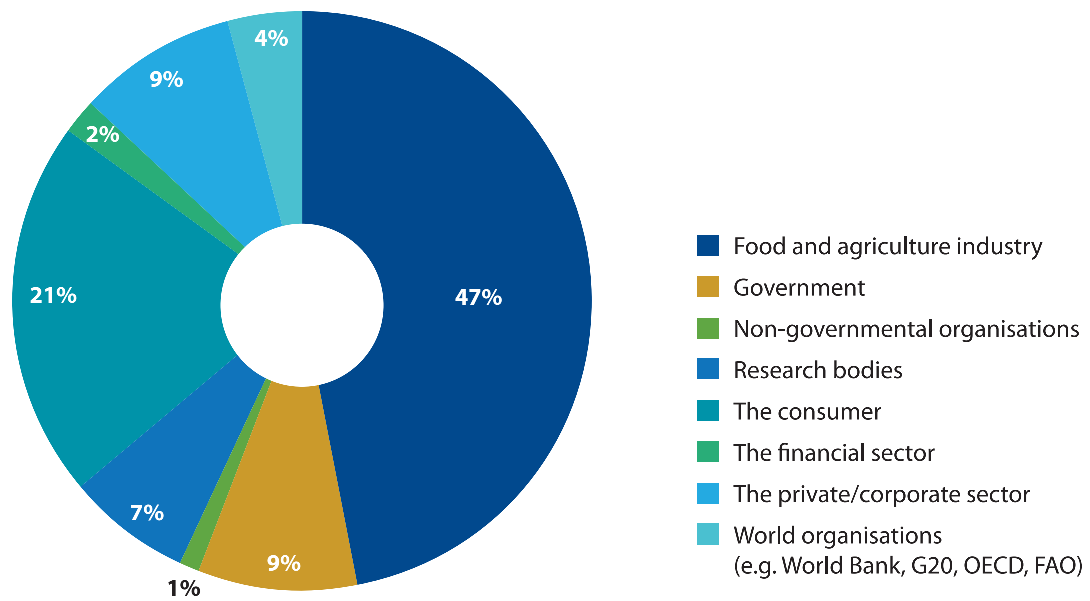
The global growth of aquaculture and trends in community attitudes toward certain commercial fishing practices may mean that volumes in some commercial fisheries will have limited future scope for significant growth. As such, ensuring that these fisheries remain viable in a current or potentially lower future production volume environment is critical. This will require knowledge and technology that improves predictability of the impact of environmental changes, the efficiency of the catch targeting process and operations more generally, particularly in an operating environment which is likely to see major input costs such as diesel increase[67].

03 Conclusion

Based on the best and most recent data and research available, this report has outlined key factors that are believed to be effecting food security in WA. While currently the WA population is fed and the state enjoys economic growth via agriculture exports, many factors are converging that will challenge food security into the future. This report has described such factors and their impacts, contributing to a stock of knowledge needed for awareness and future planning.

In conclusion, based on research conducted by Rabobank, food security has no single owner. Real progress and a food secure future in WA can only be achieved by way of collective solutions and an acknowledgment of shared responsibility among stakeholders, from farmers, to suppliers, to governments, to research institutions and to consumers (Figure 16)[68].

Figure 16. Responsibility for food security (by % believed to be responsible)



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