Australian Government
Department of Agriculture, Fisheries and Forestry

Future Drought Fund

Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

REGIONAL DROUGHT RESILIENCE PLAN

For the Mid West region incorporating the City of Greater Geraldton and the Shires of Chapman Valley and Northampton

MID WEST DEVELOPMENT COMMISSION

NACC

City of Greater Geraldton
a vibrant future

Shire of Chapman Valley
love the rural life!

Shire of Northampton

CONTACT DETAILS

Mid West Development Commission
20 Gregory St, Geraldton WA 6530

Telephone: (08) 9956 8555
Email: info@mwdc.wa.gov.au
Website: www.mwdc.wa.gov.au

DISCLAIMER

This document was compiled by partner organisations Mid West Development Commission and Northern Agricultural Catchments Council (NACC NRM) with contributions from Dr Fiamma Riviera (NACC NRM), Katherine Allen (NACC NRM), Mike Bowley (Mid West Development Commission), Kaylene Parker (Great Southern Development Commission) and Renee Manning (Wheatbelt Development Commission).

The information, data, opinions, evaluations, assessments and analysis referred to in, or relied upon in the preparation of, this document have been obtained from and are based on sources believed by us to be reliable and up to date, but no responsibility will be accepted for any error of fact or opinion. To the extent permitted by law, the opinions, recommendations, assessments and conclusions contained in this document are expressed without any warranties of any kind, express or implied. It is anticipated that elements of this inaugural Regional Drought Resilience Plan will require review and updating as new information and research become available.

The interventions identified in this Plan are conceptual and not endorsed by the State of Western Australia. The implementation of these resilience building interventions and the proposed actions is subject to further development, feasibility studies and endorsement with consortia stakeholders and lead delivery agencies.

The Chief Executive Officer of the Mid West Development Commission and the State of Western Australia accept no liability whatsoever by reason of negligence or otherwise arising from the use or release of this information or any part of it.

Accessibility: This plan is available in alternative formats on request.
An electronic copy of this plan may be obtained at www.mwdc.wa.gov.au

TABLE OF CONTENTS

ACKNOWLEDGEMENT OF COUNTRY

We respectfully acknowledge the Southern Yamatji people, who are the Traditional Owners and original natural resource managers of the lands and waters in the City of Greater Geraldton, the Shire of Chapman Valley and the Shire of Northampton, including the Amangu, Widi, Wadjari, Wilunyu, Naaguja, Nhanda and Nhanhagardi people.

We pay our respect to their Elders and leaders, past, present and emerging.

This program is jointly funded through the Australian Government's Future Drought Fund and the Western Australian Government through the Department of Primary Industries and Regional Development.

The Regional Drought Resilience Planning program for the Mid West is a locally led project that champions drought resilience and preparedness in the region. It has been led by the Mid West Development Commission in partnership with the Northern Agricultural Catchments Council NRM, and supported by the City of Greater Geraldton, the Shire of Chapman Valley and the Shire of Northampton.

We would like to thank the nearly 600 people representing at least 140 different organisations who contributed to the development of this plan through their participation in interviews, meetings and workshops. This includes a diversity of Aboriginal and non-Aboriginal organisations, with direct grower representation from groups such as the Northern Agri Group, Mullewa Dryland Farmers Initiative, Yuna Farm Improvement Group, Midwest Horticulture Grower Group, and the Northern Biosecurity Group.

We particularly thank the members of the Mid West Project Advisory Group for their enthusiastic input and advice on the stakeholder engagement and consultation process, technical components, and drought resilience actions to ensure the needs and priorities of the region are met.

In-kind contributions from the Climate Science, Geographic Information, and Policy, Innovation and Performance teams at the Department of Primary Industries and Regional Development, and the work of consultants who undertook literature reviews and data syntheses on our behalf were integral to the development of this document.

We thank the members of the RDRP Steering Committee and the RDRP Technical Working Group for their contributions to development, review and refinement of the Drought Vulnerability Assessment for the Mid West incorporating the City of Greater Geraldton and Shires of Chapman Valley and Northampton, and this plan.

Finally, we would like to acknowledge the support, contribution and working relationships with the Wheatbelt and Great Southern Development Commissions.

Mid West Project Advisory Group

Nicole Batten
Shire of Chapman Valley
Yuna Farm Improvement Group

Rob Grima
Planfarm

Fiamma Riviera
NACC NRM

Maurice Battilana
Shire of Chapman Valley

Candy Hudson
National Recovery and Resilience Agency

Trevor Royce
Shire of Chapman Valley

Amanda Bourne
NACC NRM

Marieke Jensen
Northern Biosecurity Group

Liz Sudlow
Shire of Northampton

Mike Bowley
Mid West Development Commision

Megan O'Grady
City of Greater Geraldton

Christine Zaicou-Kunesch
Department of Primary Industries and Rural Development

Fleur Coaker
Department of Water and Environmental Regulation

Tina Parkhurst
Bush Heritage Australia
Murdoch University

FOREWORD

The Northern Wheatbelt of Western Australia, also known as the Mid West region, has been a sentinel for climate variability in recent decades with defining droughts being a feature of the changing climate.

The back-to-back droughts of 2006 and 2007 has defined this region's capability to respond to droughts. This region undertook good planning, implemented 'hand up, not hand out' support measures, and built effective community networks that focus on preparedness and ongoing resilience.

The Mid West Development Commission recognises it is the people of the region who manage our sustainable resources of land and water, and they drive the economic benefits which sustain our communities. Our people are the social fabric that bind us together when times are tough and strengthen our ability to respond to events or disasters. This has been again exemplified in the wake of Severe Tropical Cyclone Seroja, which impacted on the Shires of Northampton, Chapman Valley, and City of Greater Geraldton – among numerous other Mid West local government areas – in April 2021.

We have been pleased to join with these Shires as key partners, with Northern Agricultural Catchments Council (NACC NRM) and the Department of Primary Industries and Regional Development to develop this plan.

The Mid West region plan leverages from the vast knowledge of our people through a deep engagement and consultative approach. It identifies the priorities to deliver a shared vision of continued leadership in drought adaptation and preparedness, using collaborative and integrated approaches.

We look forward to the successful implementation of this plan.

Nils Hay
Chief Executive Officer
Mid West Development Commission

EXECUTIVE SUMMARY

The Mid West region, as defined in this document, is one of three regions developing Regional Drought Resilience Plans (RDRPs) in Western Australia. The Mid West Development Commission (MWDC) partnered with the Northern Agricultural Catchments Council (NACC NRM) and the Department of Primary Industries and Regional Development to support the delivery of the RDRP for the area encompassing the City of Greater Geraldton and the Shires of Chapman Valley and Northampton. Stakeholder consultation facilitated the contributions of almost 600 individuals representing 140 organisations to the RDRP and its evidence base, the Drought Vulnerability Assessment (DVA). The DVA informs and should be read in conjunction with the RDRP.

The Mid West region's agricultural sector has a history of active engagement in climate adaptation and drought preparedness, and has been active in its response to prolonged dry conditions. However, it is recognised that more can be done to build on existing drought resilience interventions.

The Mid West RDRP outlines key priorities for building regional drought resilience and preparedness which align with the Future Drought Fund's strategic priorities of social, environmental and economic resilience.

The Mid West region's stakeholders identified three top priorities to build drought resilience in the region, including:

- Continued improvement and uptake of adaptive farming practices
- Increased support for community networks and groups
- Improved financial mechanisms

The priorities and actions within the Mid West RDRP include a broad range of investment opportunities and align with the actions of the Drought Resilience Funding Plan 2020-2024.

The Mid West RDRP is intended to be a living document, guiding State, Federal and local government, community and industry action on drought resilience. Implementation of the RDRP is subject to further discussion with project partners and local government stakeholders. An Investment Framework will identify high impact and high feasibility interventions that can be further developed into investable projects.

INTRODUCTION

Australia is a country with a history of drought. In the Mid West region, unprecedented dry weather over several decades, has adversely affected the agricultural sector and agriculturally dependent rural and regional communities.

These impacts are expected to become more frequent and severe with climate change. Proactive regional drought resilience planning is imperative to developing locally applicable solutions and responses.

The Australian Government's Future Drought Fund (FDF) provides secure, continuous funding for drought resilience initiatives, including the development of regional drought resilience plans (RDRP) across States and Territories. RDRPs focus on innovative ways to build regional drought resilience across the agricultural sector and supporting industries, through a triple bottom line, collaborative, and evidence-based approach.

As part of the inaugural year of the program in Western Australia (WA), RDRPs have been developed for three regions, selected due to their reliance on agriculture, and their location in the Bureau of Meteorology's South West Land Division forecasting area. This is amongst the regions most impacted by climate change in Australia, experiencing consistent reduction in rainfall over the last several decades (Figure 1).

"The first one I experienced as a young fella was in 1969… coming home and seeing no feed and hungry cattle, hungry sheep… it caught us unawares, it was a big learning curve."

– Jerry Clune, Bringo, City of Greater Geraldton

Listen to Jerry talk about his long experience with drought and drought preparedness in the Mid West region, here.

The three regions and their local consortia are:

- Northern Agricultural – MWDC, NACC NRM and the three local government areas (LGAs) of Greater Geraldton, Chapman Valley and Northampton
- Southern Wheatbelt – Wheatbelt Development Commission and the five LGAs of Dumbleyung, Kulin, Kondinin, Lake Grace and Wagin
- Great Southern Inland – Great Southern Development Commission and the eight LGAs of Jerramungup, Kent, Gnowangerup, Katanning, Kojonup, Cranbrook, Woodanilling and Broomehill-Tambellup.

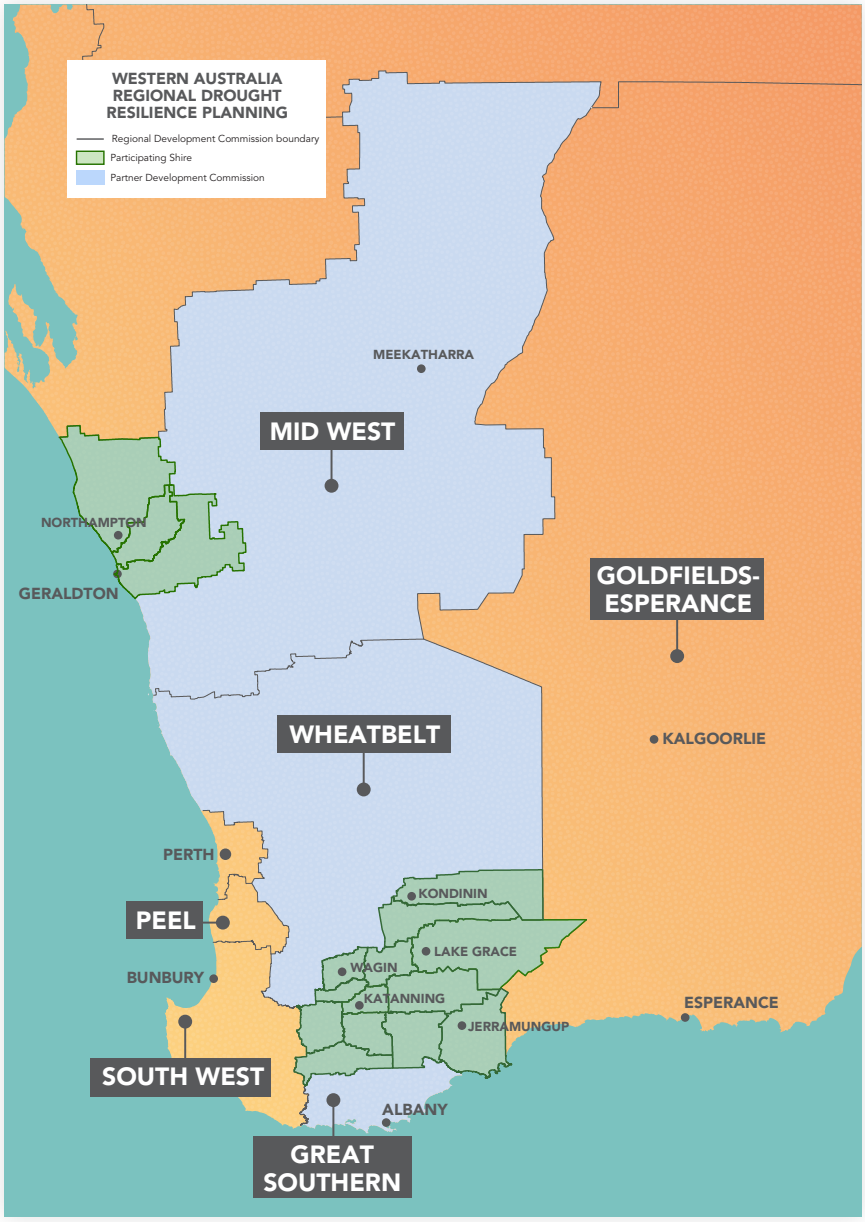


Figure 1. WA RDRP regions in context of Regional Development Commission (RDC) regional boundaries.

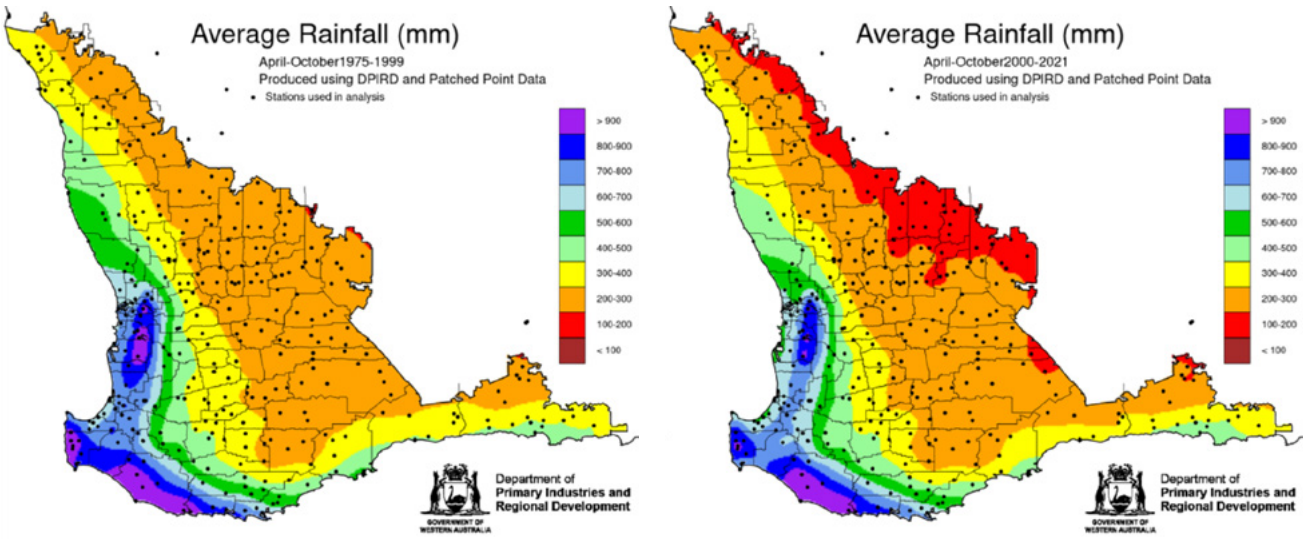


Figure 2: Change in growing season rainfall between 1975 and 1999 (left) and 2000 and 2021 (right) using data from the Patched Point Bureau of Meteorological Stations and Department of Primary Industries and Regional Development weather stations.

The planning process for the Regional Drought Resilience Plan for the Mid West region: incorporating the City of Greater Geraldton and Shires of Chapman Valley and Northampton involved a four stage process (Figure 3).

1. A broad governance structure.
2. A Drought Vulnerability Assessment to provide a robust evidence base using wide consultation
3. The Regional Drought Resilience Plan, which provides a high-level summary of the findings from the DVA. The Plan includes actions and interventions to mitigate drought impacts in the region.
4. An Investment Framework

The Mid West RDRP should be read in conjunction with the Mid West DVA.

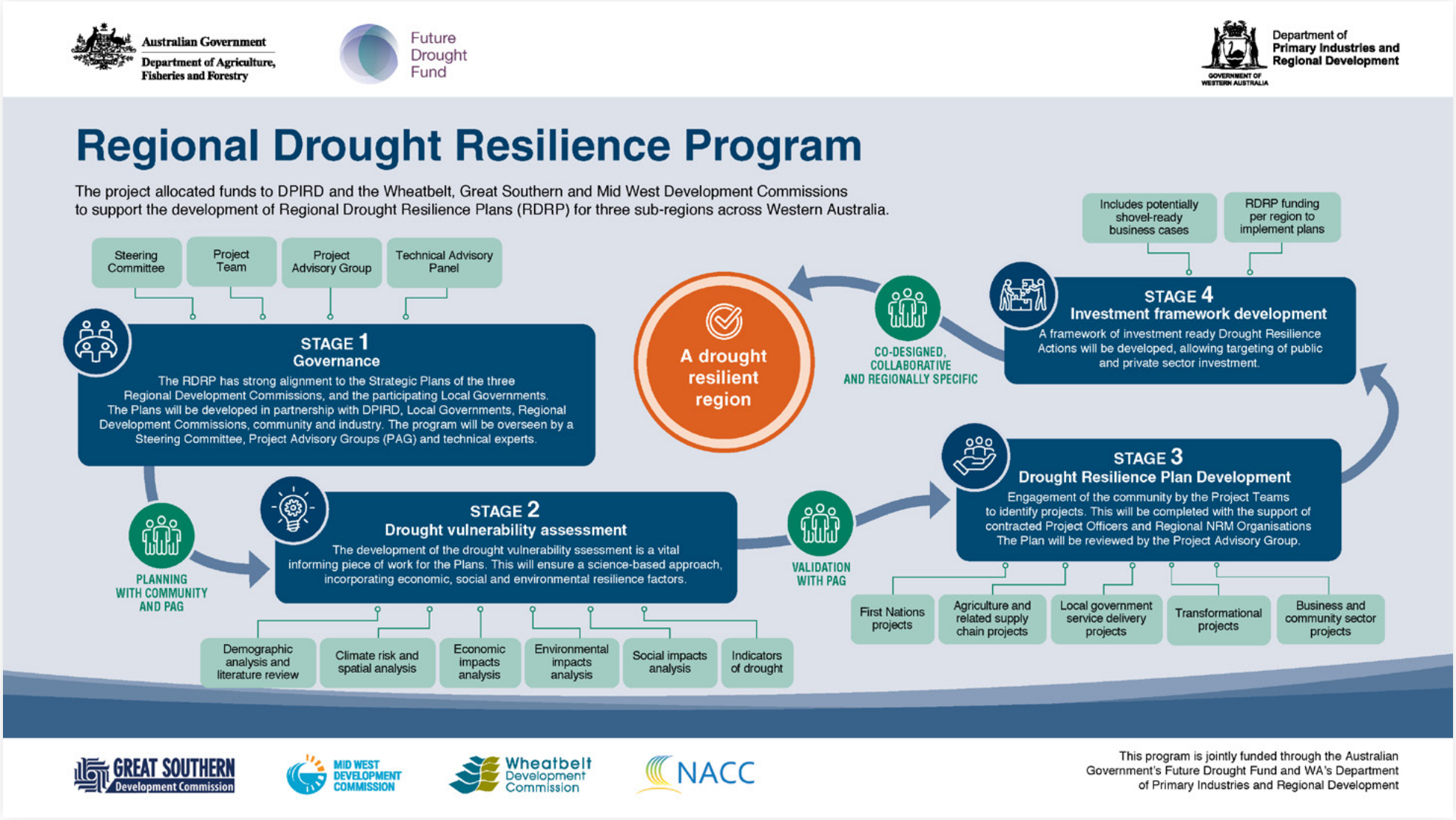


Figure 3: Regional Drought Resilience Program framework.

The Mid West region is often referred to as the 'sentinel' of drying and heating trends forecast for the South West Land Division under all climate change scenarios due its location at the limit of the winter rainfall climatic zone.

As such, primary producers in the region have been the vanguard of adaptive agricultural practices. The drought of 2006 and 2007 delivered the Mid West region's lowest and third lowest rainfall on record.

Economic, environmental and social impacts were wide ranging, and endured into 2008 and beyond. In response, primary producers demonstrated a strong commitment to continued changes across agricultural practices, increases in agronomic effectiveness and efficiency, and a vision on increased resilience through a 'hand-up approach', not 'hand-outs'.

DEVELOPING OUR VISION

The purpose of the RDRP is to identify actions to prepare for increased climate variability, reduced growing season rainfall, and an increased number of drought events. This plan will inform future investments and assist in securing future funding for communities, the agricultural sector and regional businesses to help increase drought resilience in our region.

Our drought resilience vision for the Mid West region is based on a grass roots assessment of what can realistically be achieved at a community, government and industry level to ensure the region is prepared for more frequent and severe droughts in the future. By creating a shared vision and agreed goals and outcomes, we have set a common direction and aspirational view of our region's future from a drought resilience perspective.

The broad engagement and consultation in the development of this Mid West RDRP revealed the vision:

A self-reliant agricultural community, capable of withstanding the challenges of drought through shared responsibility and an integrated approach to drought management and preparedness.

GOALS AND OUTCOMES

The insights outlined in the Mid West RDRP recognise the ongoing economic, environmental, and social impacts of drought and are intended to be a practical and applicable resource that can be used by farming communities, local governments, academics, industry groups and government agencies to inform decision making, attract funding and guide investment.

The goal is that this RDRP will position the Mid West region to take advantage of emerging opportunities to continue to build sustainable agri-businesses, landscapes and communities, and for regional organisations, local government, community and industry to work in partnership.

The Mid West RDRP also outlines key priorities which community stakeholders have identified as crucial to further addressing drought resilience in the region. Associated actions to address these priorities have been developed which capture local and regional initiatives, industry innovations and diversification, and best-practice initiatives from outside the regions.

By aspiring to its vision, goal, priorities and actions, the following outcomes in the Mid West region will be achieved:

- The ability to identify and plan for the impacts of drought;
- Strengthen the ability to adapt to changes and take advantage of opportunities as they arise;
- Build economic, environmental and social resilience to future droughts;
- Learn from other regions' RDRPs, sharing what is working and what is not;
- Form stronger connections and relationships within and between regions;
- Access best practice data and information to make better decisions and inform investment opportunities as they arise; and
- Improving natural resource management across the region.

The Mid West region's vision, goal and priorities reflect the vision, aim, strategic priorities and objectives of the Drought Resilience Funding Plan 2020-2024.

DEFINITIONS

Adaptive Capacity

The extent to which a system is able to exploit opportunities and resist or adjust to change. For the Mid West RDRP, adaptive capacity is measured in terms of historical response to droughts in the Mid West region or estimated according to a set of vulnerability proxies such as income, education, community participation rates and drought resilience of natural features.

Drought

The need for a regionally appropriate definition of drought was raised during all stakeholder engagement for the RDRP. Engagement with primary producers and agribusiness indicated that growing season rainfall was most important to the Mid West region, with several noting the recent trend of the early onset of hot days in spring.

Community groups defined drought as 'consecutive dry seasons where there is inadequate growing season rainfall over two or more seasons.' Indicators that they are in a drought were the lack of opening rains to commence their seeding operations, reduced growing season rainfall, less rainfall events that result in reduced run-off, and reduced spring rainfall.

The Technical Working Group further expanded the need for drought definitions to include social, environmental and economic impacts. The technical working group (TWG) defined drought for the WA RDRP program as follows:

The term drought refers to a prolonged period of abnormally dry conditions that impact negatively on water availability and agricultural production in a region and, consequently, impacts negatively on the economy and environment of the region and the health and well-being of its residents.

"We really feel that we need at least a 150mm of rainfall during the growing season… a drought is anything less than that… One of the other issues is what they call a hot drought…"

– Liz Sudlow, Northampton, Shire of Northampton

Listen to Liz talk about her thoughts on drought definition, and more, here.

An assessment of meteorological definitions of drought indicated that a definition based on growing season rainfall (between April to October) is considered more appropriate for the South West Land Division than a definition based on total annual rainfall, and that the inclusion of heat in definitions should be further investigated, particularly for the Mid West region. Growing season rainfall better represents agricultural drought in the region, where dryland cropping in autumn and winter is the primary land use. Livestock also require water for runoff into dams and/or bore water to meet their demands during droughts.

Exposure

The extent to which a given system, community or region will be subjected to a particular hazard. For the Mid West RDRP, exposure is measured in terms of the extent to which the Mid West region will be exposed to drought and drought-related climate change processes.

Resilience

The capacity of a rural community and landscape as a social-ecological system to absorb disturbance, reorganize, maintain or change functions and feedbacks so as to continue to deliver values.

Sensitivity

The extent to which a given system, community or region will be affected by a particular hazard. For the Mid West RDRP, sensitivity is fundamentally about the ways in which the Mid West region is impacted by drought.

A more in-depth analysis of terms and definitions can be found in the Mid West DVA.

STAKEHOLDER ENGAGEMENT AND CONSULTATION

As part of a deliberative regional Mid West stakeholder engagement process, project partners worked collaboratively to:

- Demonstrate the Federal and WA Governments' commitment to supporting farm businesses and communities to become more prepared for, and resilient to, the impacts of drought;
- Identify the appropriate target audiences, share program benefits and promote the importance of becoming drought-resilient and drought-prepared;
- Engage local stakeholders in each region, undertaking communication activities that promoted the importance of regional-scale planning, building commitment to the process and strengthening partnerships between relevant stakeholders; and
- Maximise participation and engagement in regional planning processes.

Strong partnerships were key in the successful delivery of the RDRP program. Figure 4 outlines the governance framework which supported the achievement of the engagement goals.

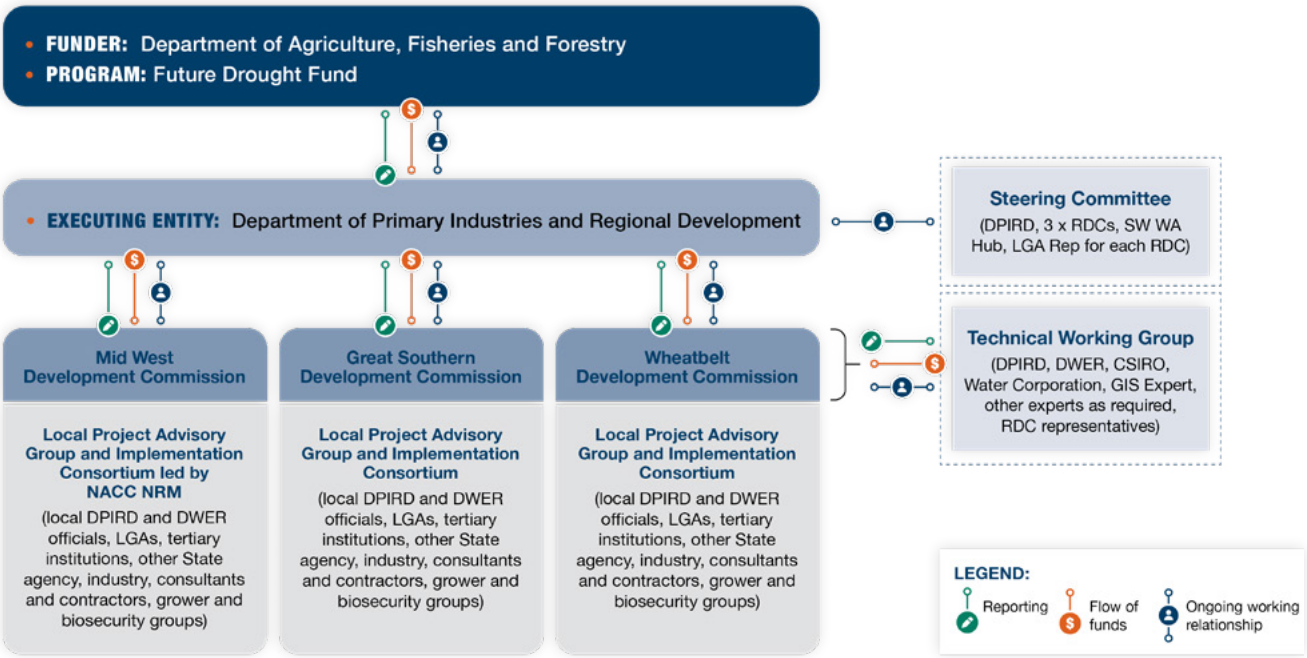


Figure 4: Governance framework for the WA Regional Drought Resilience Planning program.

Broad stakeholder engagement and consultation was key to the development of the Mid West RDRP and Mid West DVA. The TWG was instrumental in informing the evidence base required for the development of these documents. The Mid West Project Advisory Group (PAG) provided local knowledge to support targeted engagement, review of technical inputs, and advice on identified drought resilience actions. Community consultation, conducted by MWDC and NACC NRM, was a critical component in the development of this plan and the DVA.

Consultation was guided by the FDF's three strategic priorities of economic, environmental and social resilience. Sessions focused on identifying the perceptions, experiences and associated risks of drought, reviewing emerging technical analyses from the Mid West DVA, sharing the results of earlier engagement efforts, and identifying drought resilience actions for inclusion in the Mid West RDRP. Stakeholder engagement and consultation occurred between October 2021 and June 2022 with participation from almost 600 people representing 140 different organisations and businesses (Figure 5).

In addition to this consultation work, a review of drought innovation was commissioned to identify transformative resilience projects and assess their potential application to regional WA (Appendix 1). The review was conducted under seven resilience research areas: water, digital, farm business, farming system, natural capital, community and regional economy. Areas of research were developed and workshopped with each WA region to further identify and support key local priorities and actions.

Effective, early and on-going engagement throughout the project allowed for a diverse range of region-specific knowledge and skills to be harnessed, resulting in a collectively owned region-specific plan for the Mid West region. As a result of this process key Mid West priorities were identified within each of the three FDF strategic priorities (Figure 6).

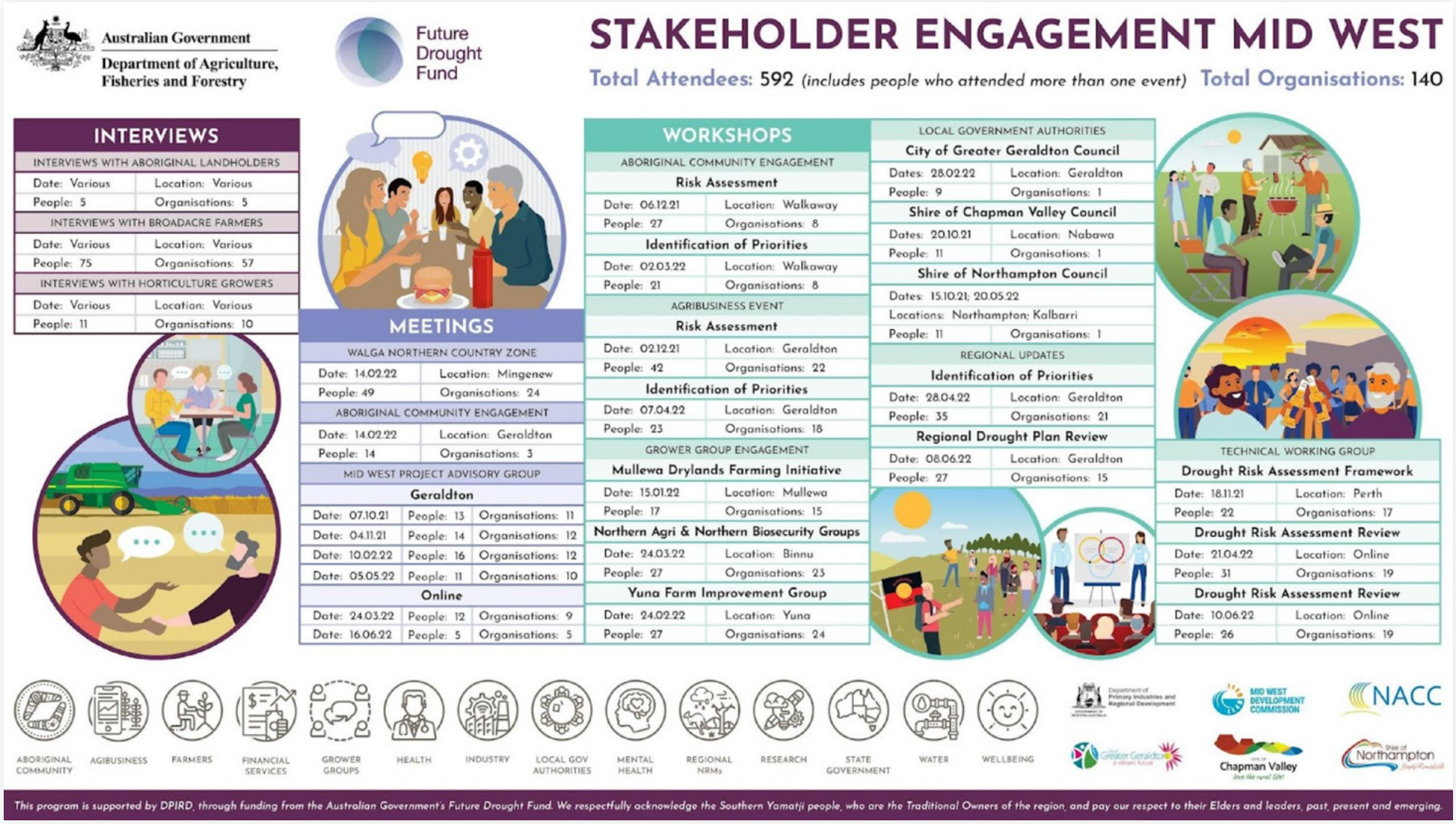


Figure 5. Mid West RDRP stakeholder engagement summary.

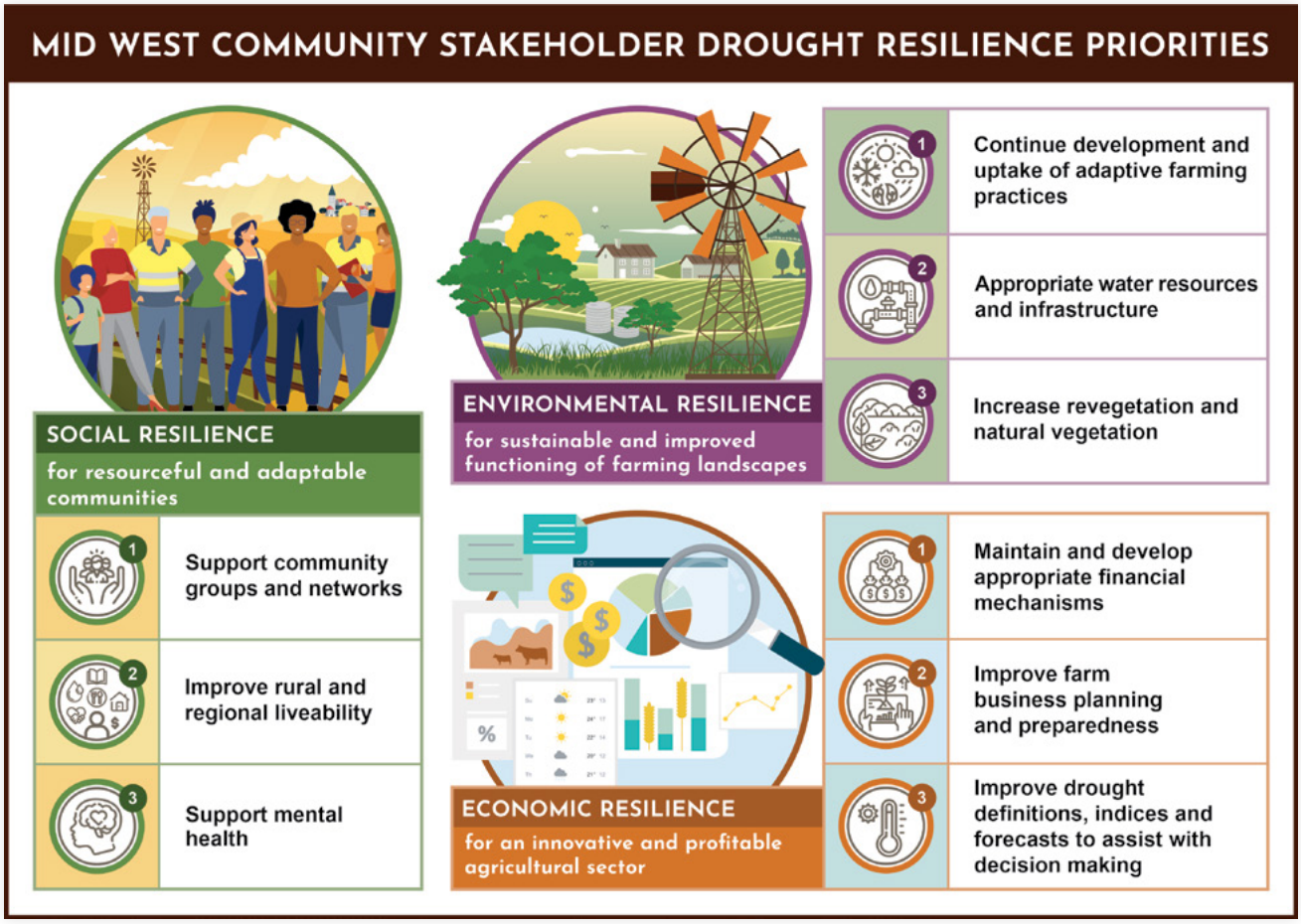


Figure 6. Mid West RDRP community consultation drought resilience priorities aligned with FDF strategic priorities.

DEVELOPING THE EVIDENCE BASE

The development of the DVA provides the evidence base for the actions identified in the RDRP to mitigate drought impacts in the Mid West region.

The DVA comprised of a literature review, socio-economic analysis, spatial prioritisation, risk assessment, and additional input and analysis from technical experts, research professionals and industry leaders.

Extensive stakeholder and community engagement allowed for the harnessing of perspectives and insights from people's lived experience and provided the opportunity to better understand how the region has been affected by drought in the past, and what has already been done to mitigate the impacts of future droughts.

This in-depth evidence base supports:

- Improved understanding of the impacts of drought in the Mid West region;
- Synthesis of program and policy initiatives related to drought at a local, regional, State and Federal level;
- Investigation of alternative definitions of drought, based on growing season rainfall, better suited to the broadacre cropping areas of the Mid West region;
- In depth analyses of the economic, environmental, social and water impacts of drought, including the impacts of drought on Aboriginal communities;
- Development of a multi-criteria mapping methodology that synthesises a large number of datasets into a single decision-support tool highlighting priority areas for investment in resilience building activities;
- An exploration of how readily measurable biophysical and socio-economic factors, often publicly available data, might serve as indicators of drought and be used to understand and/or predict the impacts of drought; and
- A drought vulnerability index using the data collected to create the drought risk priority areas map.

Figure 7 outlines the key information sources used to develop the Drought Vulnerability Assessment in WA, with the broad range of information sources that contribute to the final Drought Resilience Assessment.

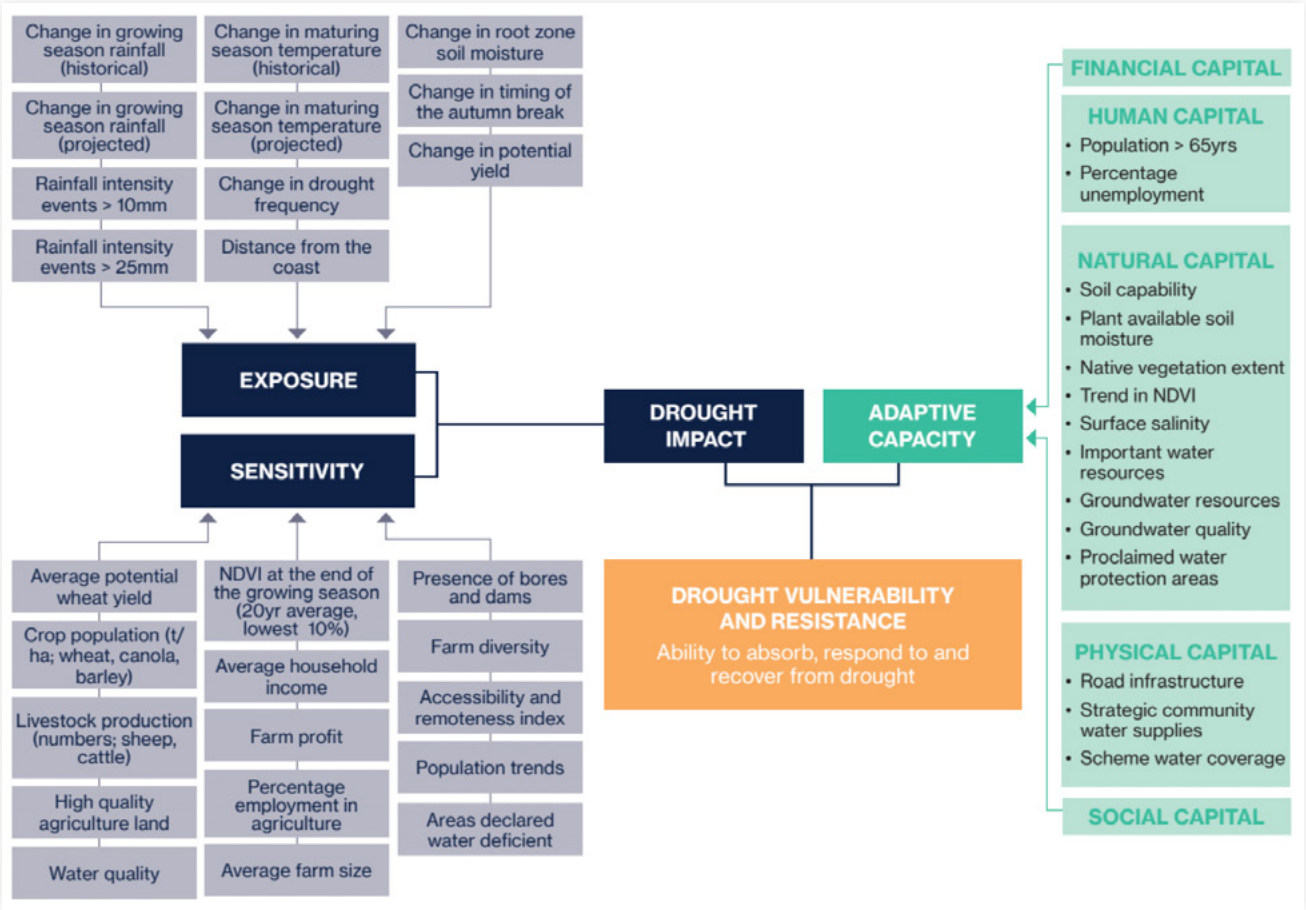


Figure 7. Overview of the Drought Vulnerability Assessment development process.

DVA METHODOLOGY COMPONENTS

Stakeholder Engagement

Stakeholder engagement was a critical component of the vulnerability assessment process (Figure 3). A stakeholder mapping process was undertaken to identify groups and individuals to consult on the development of the RDRP. Stakeholders identified through this process included local government authorities, farmers and their representative bodies, agribusiness, Traditional Owners, community groups and NGOs, research institutions and the local offices and technical teams of State and Federal Government agencies.

Consultation with stakeholders enabled an understanding of how people living in the region had experienced and responded to drought in the past, what they had done to mitigate drought risk, their perceived risk of being impacted by drought in the future, what a drought resilient region looked like to them and what priority actions they had in mind to ensure drought resilience in the future. A Technical Working Group (TWG) provided input and review of the key elements of the DVA model, including identification of important datasets to inform the assessment process. Membership of the TWG membership included DPIRD climate scientists, CSIRO, University of Western Australia's Centre for Social Impact, Curtin University's Centre for Crop Disease Management, Murdoch University's Harry Butler Institute, Planfarm and Noongar Land Enterprises.

A Steering Committee provided high level support and direction to the project team and was chaired by the CEO of the Wheatbelt Development Commission, with representation from the participating RDCs and local governments, and the Director of the South-West of WA Drought Resilience and Adoption Hub. NACC-NRM was contracted to assist with consultation with grower groups, farm advisors, farming champions and the Project Advisory Group. They also worked in cooperation with First Nations representatives across the region. They used a range of methods including participatory workshops, interviews and regional surveys.

Stakeholder consultation followed the RDRP conceptual framework, investigating aspects of exposure, sensitivity, impact and adaptive capacity and the ways in which each of these relate to and inform vulnerability and resilience to drought in the region. Stakeholder engagement between October 2021 and February 2022 focused on identifying the ways in which the local community understands and defines drought, how they have been impacted by drought in the past, how they responded during the most recent severe drought in 2006 and 2007, and how they now prepare and plan for future droughts. Consultation sessions from February to June 2022 focused on reviewing emerging technical analyses, sharing the results of earlier consultation efforts, identifying key priorities for the region, and identifying drought resilience actions for inclusion in the RDRP and development into future projects. From June 2022 onwards, consultation focused on reviewing and finalising the draft RDRP. 592 people were consulted, representing 140 organisations and businesses.

Desktop Review

Desktop review is a critical component of any vulnerability assessment process. It involves identifying, summarising and interpreting what is already known about the impacts of the hazard on drought. The desktop review followed the development of the RDRP conceptual framework, and investigated aspects of exposure, sensitivity, impact and adaptive capacity and the ways in which each of these relate to and inform vulnerability and resilience to drought in the regions.

The desktop review included an overview of existing data, research, tools and resources that informed our stakeholders' understanding of drought impacts and drought preparedness across the focus regions. It included a socio-economic and land-use profile of the region, describing the population, major land-uses and economic activities, the threatening processes they face and what that means in terms of drought resilience.

The review identified those actively working to support drought resilience in the region, including their respective roles and relationships between them, and summarised existing and past drought resilience policies and plans across a range of levels, from local to international, and the suite of drought resilience programs currently operating in Western Australia and Australia.

Spatial Prioritisation

The spatial component of the DVA used mapping software to map drought resilience priority areas. All spatial data was prepared and presented at the scale of local administrative boundaries, to best support local level decision-making and investment.

Inputs into the multi-criteria analysis (MCA) were determined following the development of the RDRP conceptual framework, and include exposure, sensitivity, impact and adaptive capacity and the ways in which each of these relate to and inform vulnerability and resilience to drought in the regions. Spatial data layers include:

- climate data (historical and projected change in rainfall, temperature, soil moisture and drought frequency and severity);
- environmental data (soil type, topography, ground and surface water resources, native vegetation extent, ground cover, normalized difference vegetation index);
- production data (crop yields, animal production, type of farming system);
- financial data (household income, farm profitability, use of farm management deposit schemes);
- social data (population trends, access to services, community participation rates); and
- infrastructure data (roads, water supplies).

Composite maps showing how different features of drought risk and resilience are overlaid in the regional landscapes are created using a standard multi-criterion GIS analysis (MCA). Priority areas for investment in drought resilience projects or programs are highlighted at the overlap between spatial datasets that highlight where drought is likely to occur, where there are features that are likely to provide resilience to the impacts of drought (e.g. high ground cover, lots of water resources, drought resilient farming systems) and where vulnerable communities of people are likely to be impacted by drought (e.g. remote communities with limited access to services).

Risk Assessment

A drought risk assessment collates all the data collected and analysed from the stakeholder engagement, desktop review and spatial prioritisation components, and provides local decision-makers with a summary of vulnerability to drought in their region. Synthesis of the data into a risk assessment followed the development of the RDRP conceptual framework and investigated aspects of exposure, sensitivity, impact and adaptive capacity and the ways in which each of these relate to and inform vulnerability and resilience to drought in the regions.

The aim of a risk assessment summary is to assist local decision makers and managers in the rapid evaluation of drought vulnerability for the region and enable tracking of change over time. Data in each drought impact category (i.e., social, financial, production, environmental) can be scored along a sliding scale and assessed over medium and long-term timeframes in terms of drought risk and resilience.

Technical Expertise

To strengthen the evidence base, the following technical reports were commissioned to gain regionally specific insights into drought resilience. These insights informed the Mid West DVA and were drawn from:

- **Socio-economic and drought policy review (Anna Dixon Consulting):** review for the three WA regions.
- **Drought Indices (CSIRO):** Repeated the recent CSIRO NSW drought indicators exercise by deploying a Random Forest Analysis to Nous data relevant to the three WA regions.
- **Defining Drought in WA (Curtin University):** Assessment of the suitability of the current BoM definition of drought in decile 1 over two or more consecutive years and investigation of other drought definitions or indices appropriate for the regions.
- **Drought Risk Assessment (DPIRD):** Analysis of historical and future drought risk scenarios for each region.
- **Economic and Environmental Impacts of Drought (LA One Economics and Consulting):** Review of historical and potential future economic and environmental impacts of drought on farming businesses, communities, agribusiness and supply chain sectors in the region.
- **Social Impacts of Drought (UWA):** Identification of primary social impacts of drought in the region and assessment of the effectiveness of actions taken in the past.
- **Drought Impacts on Water Resources in the Mid West (MWDC):** overview of drought impacts on current water sources in the Mid West, and the identification of future supplies and opportunities to build greater water resilience.
- **Farm business viability analysis (Planfarm):** analysis of the financial response of a cohort of farm businesses in the Mid West region to drought.

The DVA also considered specific knowledge and skills from the following sources:

- Relevant Council plans
- Economic Development Plans
- Strategic Community Plans
- Australian Drought Plan
- Regional Development Commission Strategic Plans
- WA Government Climate Policy
- State Infrastructure Plans
- South West WA Drought Adoption and Innovation Hub

The Mid West RDRP evidence base was further informed by previous and current strategies such as the North Eastern Agricultural Region Strategy and the Australian Government Drought Response, Resilience and Preparedness Plan, along with a review of relevant science-based initiatives, such as the DPIRD WaterSmart Farms project.

There are limitations to some of the datasets used in the assessment process, due to the granularity, frequency of data capture and scale of the data. It is recommended that the Mid West DVA be reviewed on a regular basis to integrate updated or new datasets of relevance. This will not only inform future planning and investment but enable longitudinal monitoring of drought resilience.

Plan Alignment

The Mid West RDRP is consistent with National Framework for Drought Policy (National Drought Agreement) and Australian Government Drought Response, Resilience and Preparedness Plan. The Plan has a focus on long term resilience and preparedness. The RDRP also has strong alignment with national, state, regional and local plans, strategies and policies, including:

National:

- Australian Government Future Drought Fund
- South West WA Drought Adoption and Innovation Hub

State:

- WA Government: Diversity WA 2019, Western Australian Climate Policy 2020
- Department of Water: Water for Growth 2016
- Department of Primary Industries and Regional Development: Strategic Intent 2018-2021, Primary Industries Plan 2020-2024, Western Australian Soil Health Strategy 2021-2031
- Water Corporation: Water Forever - Towards Climate Resilience 2009
- Western Australian Agricultural Research Collaboration

Regional:

- WA Government: Mid West Regional Planning and Infrastructure Framework, Mid West Sub-Regional Strategy (Guilderton to Kalbarri)
- NACC NRM: NARvis (Regional NRM Strategy for the Northern Agricultural Region)

Local:

- City of Greater Geraldton Strategic Community plan 2021-2031
- Shire of Chapman Valley: Strategic Community plan 2022-2032
- Shire of Northampton: Community Strategic Plan 2020-2030

REGIONAL DESCRIPTION

Geography and Population

The portion of the Mid West region which is covered by this plan, covers an area of 26,490 km^2, and includes the City of Greater Geraldton, and the Shires of Chapman Valley and Northampton (Figure 8). It is home to over 42,000 people. The majority of the population, services and administration are centered in Geraldton.

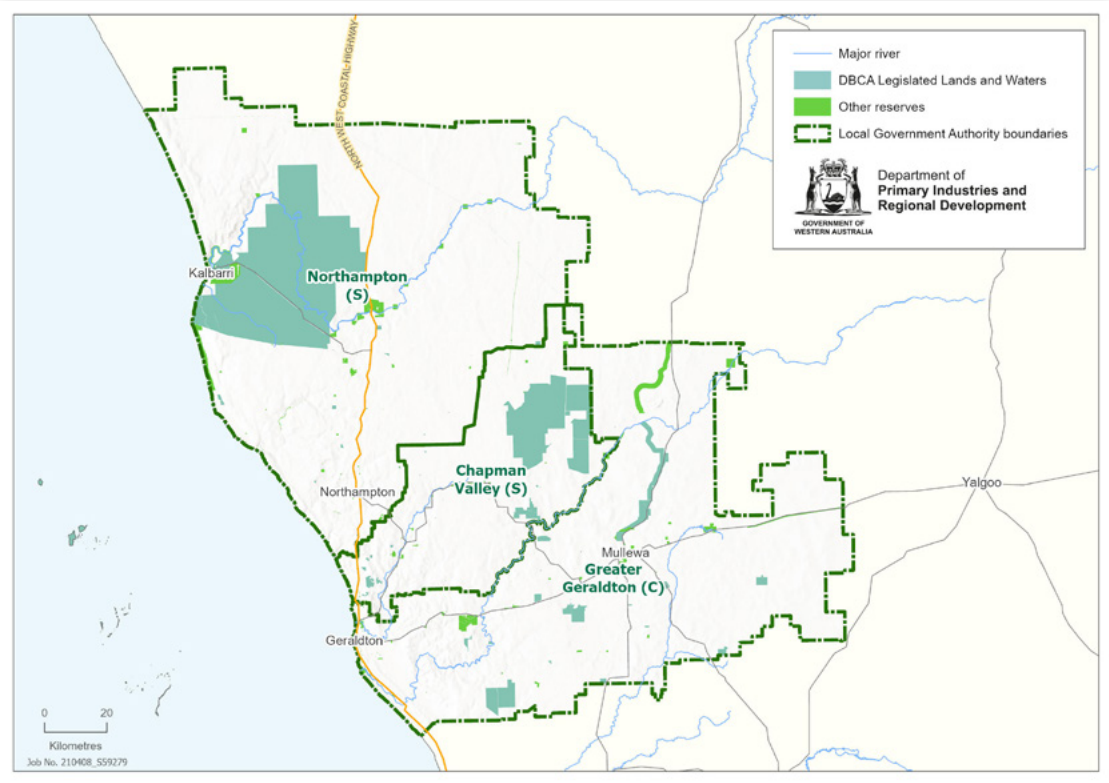


Figure 8: Geographic scope of the Mid West RDRP.

The region is located on Yamatji Country and resident Aboriginal language groups include the Amangu, Badimia, Naaguja, Nhanaghardi, Nhanda, Mullewa Wadjari, Wattandee, Widi and Wilunyu peoples. The Yamatji Southern Regional Corporation is the entity responsible for implementing the region's Indigenous Land Use Agreement.

The region covers the north west portion of the Mid West Development Commission's total region, and is the northern most limit of the WA grainbelt, bordered by the southern rangelands to the north and east, and the Indian Ocean to the west. It includes the H1 (high rainfall north), M1 (medium rainfall north) and L1 (low rainfall north) agro-economic zones as identified by the Department of Primary Industries and Regional Development.

The Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) Socio-economic Index for Areas (SEIFA) score, which measures both advantage and disadvantage, shows that Greater Geraldton and Northampton are more disadvantaged than greater regional WA and greater WA, while the Shire of Chapman Valley is more advantaged than greater regional WA and greater WA.

The Dropping off the Edge index ranks locations from 1 to 5 across 37 indicators, with 1 the highest disadvantage and 5 the least. It uses SA2 boundaries which are different to local government areas, however it can give a useful macro view of issues. The Mid West region had scores from 1-2, indicating high disadvantage and highlighting areas of vulnerability in terms of low family incomes, no internet at home, juvenile convictions, prison admissions, air quality and heat vulnerability (days over 38°C).

Economy

The largest industry sector for economic output in the Mid West region is construction with 13.85% of total output. Agriculture accounts for 7.57% of economic output in the region. While agriculture makes up only a small proportion of the overall economic output in the City of Greater Geraldton, the annual output from this sector is larger than the other two participating LGAs and is valued at $334.74 million. Agriculture is the main economic output in both the Shires of Chapman Valley and Northampton. Broadacre cropping is the dominant land use in all three LGAs, and accounts for 80-85% of agricultural value in the each, mostly from wheat production (Figure 9). The Mid West region also supports a diverse range of other agricultural activities including livestock production and horticulture (Figure 9).

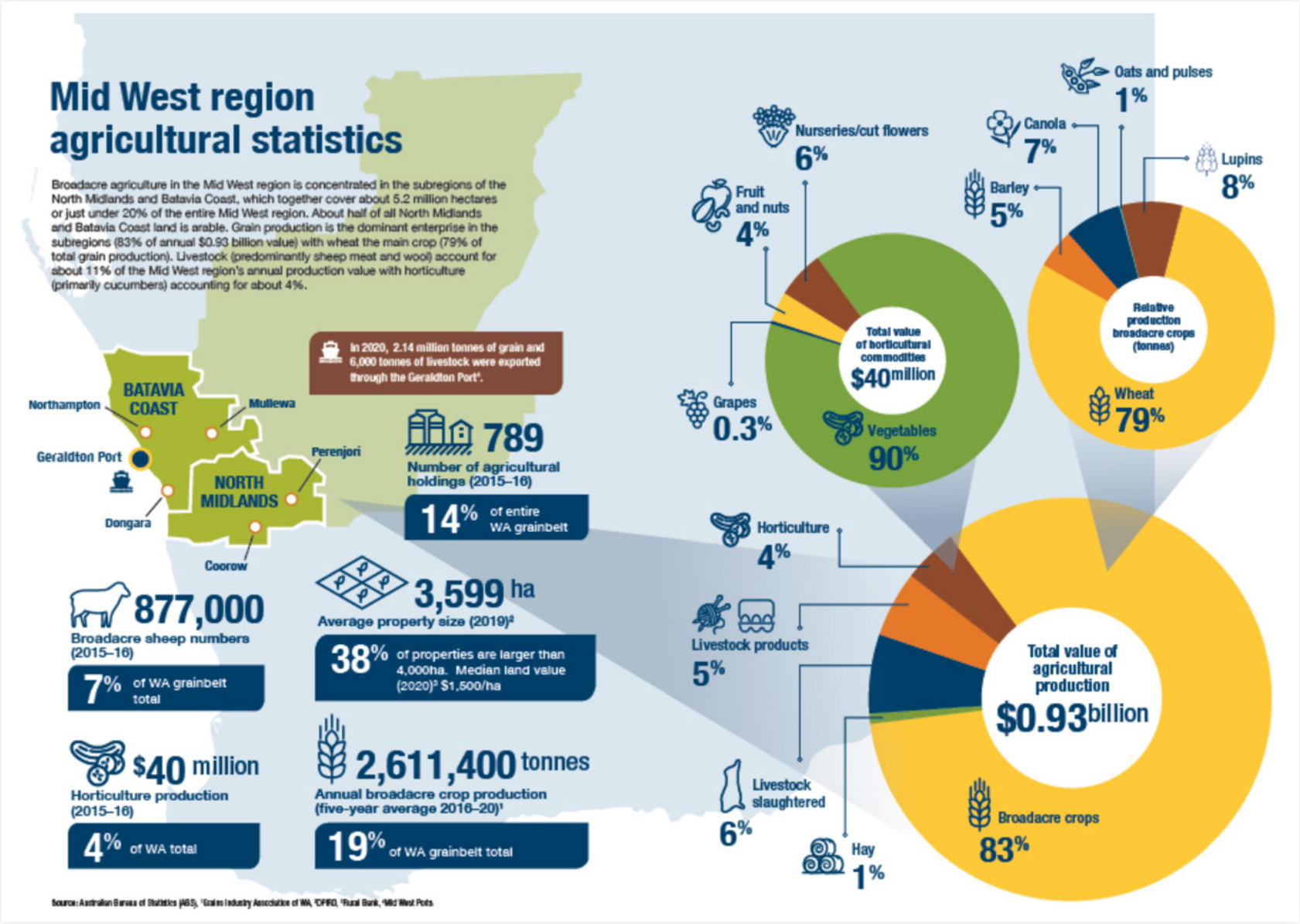


Figure 9. Agricultural outputs and statistics for the entire Mid West agricultural area. Note, this is a broader area of the Mid West region than the one defined in this Mid West RDRP (Source: DPIRD).

The largest employment sector within the Mid West region is the health care and social assistance sector, with 13.6% of jobs. Across the region 6.64% of jobs are in the agriculture, forestry and fishing sector, although individual proportions for the Shires of Chapman Valley and Northampton are much higher.

The City of Greater Geraldton has a higher level of business diversity compared to the Shires of Chapman Valley and Northampton, as is to be expected for a major regional centre. However, while primary production accounts for just 18% of businesses, at 574 the City of Greater Geraldton has the highest number of such business of the three LGAs.

While there are considerably fewer primary production-based businesses in the Shires of Chapman Valley and Northampton, they make up a much greater proportion of total business, at 53% and 40% respectively. Annual turnover in primary production businesses in the Mid West region range from less than $50,000 to more than $10,000,000.

Table 1 summarises key socio-economic statistics for the Mid West regions and each of the three LGAs.

Table 1: Key socio-economic indicators for the Mid West region and participating LGAs.

	Mid West region combined	City of Greater Geraldton	Shire of Chapman Valley	Shire of Northampton
Area (km²)	26,490	9,889	3,983	12,618
Population	42,647	38,231	1,540	2,876
Median age (years)	-	38	43	51
Labour force participation rate (%)	-	62.2	71.1	52.7
SEIFA - IRSAD Score	-	956	1,028	937
Dropping off the Edge Index	1-2	1-2	2	2
Annual economic output	$7.1 billion	$6.5 billion	$142.7 million	$425.7 million
% Economic output from agriculture	7.57%	5.15%	45.82%	32.44%
% Employment in agriculture	6.64%	4.19%	50.2%	28.9%

Landscapes and Natural Resources

The Mid West region landscapes are a mixture of distinctive flat-topped hills, mature valleys and extensive areas of undulating sandplains. The region is dissected by a number of rivers, the main ones being the Irwin, Greenough, Chapman, Bowe, Hutt and Murchison.

There are a variety of duplex soils and red earths on the valley sides and river flats. The sandplains comprise of pale deep sands and yellow deep sands which have low to moderate water holding capacity, low natural fertility, and are prone to erosion and water repellence.

Water resources in the Mid West region comprise of underground aquifers, recharged from rainfall. Most recharge occurs in the cooler months of June to September when rainfall exceeds evaporation and when rain falls over consecutive days. Aquifers support residential, agricultural, industry and environmental needs.

The Mid West region is part of the South West WA global biodiversity hotspot. Vegetation comprises largely of species rich scrub heath and thickets. Wildflowers, coastal landscapes and marine wildlife attract tourists to the region.

The WA grainbelt has experienced transformational change since European settlement and much is cleared of its natural vegetation. However, significant remnants of native vegetation on both private land and in conservation reserves remain in the Mid West region, particularly on the border of the agricultural zone and the southern rangelands. Kalbarri National Park and Wandana Nature Reserve are notable.

The region has abundant solar and wind resources, potentially well suited to in situ renewable energy production.

"Changing our focus on what is good cropping land and what is not so good cropping land… concentrating the cropping onto the loams, the better heavier soil types, and on some of the weaker sands we now establish perennials… The yellow sandplain around here can be quite fragile…"

– Jason Batten, East Yuna, Shire of Chapman Valley

Listen to Jason talk about the different soil resources on his property, and more, here.

REGIONAL STRATEGIC PRIORITIES

The WA State Government Mid West Sub-Regional Strategy, focused on well-planned regional growth and development, highlights the agriculture sector as a high value industry for the sub-region. The Mid West Regional Planning and Infrastructure Framework also highlights agriculture as a significant industry in this region. The Mid West Development Commission, focused on diversifying the region's economic base and maximising investment in local industry, has identified regional water infrastructure, economic development in the agriculture sector and regional leadership on climate change adaptation and natural resource management as priorities. The North Eastern Agricultural Region (NEAR) Strategic Plan guided the implementation of several projects in the region to increase resilience to drought, including Decision Making and Tactical Tools for 2008 and Beyond in the NEAR and Adapting to Climate Change in the NEAR. State Government priorities include expansion of the freight network in the Mid West to support agriculture, the resources sector and the local port.

Local governments in the area work together under the Batavia Regional Organisation of Councils and the City of Greater Geraldton is part of the WA Regional Capitals Alliance.

The Yamatji Southern Regional Corporation, representing Traditional Owners in the area, prioritise projects that will ensure the sustainable management of groundwater resources and water catchments.

The regional NRM Strategy for the Northern Agricultural Region (www.narvis.com.au) identifies and prioritises opportunities for NRM investment in the region. Specific areas of importance include sustainable production, soil health, water quality, adapting to climate change, and managing feral animals and weeds.

"We've got lots of creek lines… they've been reveg-ed or maintained… this allows us to utilise those areas and provide a service in natural resource management as well… We are also looking at doing some earthworks and reveg work… to help with keeping water on the farm…"

– Jason Stokes, Chapman Valley, Shire of Chapman Valley

Listen to Jason talk about revegetation and water capture projects on his property, and more, here.

Measuring Vulnerability and Resilience

Methodology

Using GIS-based multi-criteria analysis (MCA), relevant economic, environmental and social data was spatially integrated at an appropriate decision-making scale (LGA boundaries) to produce a set of maps of drought vulnerability and resilience priority areas for the South West Land Division and at the local Mid West scale. Inputs into the MCA followed the DVA conceptual framework, investigating aspects of exposure, sensitivity, impact and adaptive capacity.

These maps took into consideration farm water supply, agricultural production, soil health and erosion potential along with a range of socio-economic and landscape features that contribute to drought resilience or exacerbate drought risk. These features include water-related ecological infrastructure, high value agricultural land and areas of higher socio-economic vulnerability. The approach consolidates complex information into user-friendly spatial products designed to enable fine-scale, local-level decision making on drought resilience. Map products were ground-truthed through workshops with Mid West stakeholders representing Aboriginal community groups, broadacre farmers, agribusiness, the Mid West PAG and the TWG. Participants were asked to identify the locations most vulnerable to drought based on their past experiences with drought in the region (Figure 10). Their feedback was incorporated into the final products.

Figure 10. Ground-truthing process for MCA map products by Mid West region stakeholders.

Vulnerability Index

A Vulnerability Index was developed for the Mid West region with ten indicators chosen to reflect exposure, sensitivity and adaptive capacity. It provides a snapshot of vulnerability to drought which can be repeated and tracked over time and aims to assist local decision makers and managers in the rapid evaluation of drought risk in the region. Each indicator was rated on a sliding scale from 1-5, with 1 being the lowest vulnerability and 5 the highest.

While the vulnerability index suggests that vulnerability to drought in the region is moderate (3.3 out of 5), risk is not evenly spread amongst the factors assessed. While the region is resilient in terms of soil and production capability, it is highly exposed to the impacts of climate change (increasing temperatures, decreasing rainfall, changes in the timing of rainfall and increasingly frequent drought) and faces several general resilience challenges including economic diversification and access to infrastructure, services and reliable, good quality water.

There are limitations to some of the data in these analyses, particularly the publicly available human capital datasets utilised to inform adaptive capacity to drought. It was noted during consultation and in development of the mapping products, that the availability, quality and resolution of human capital datasets was not sufficient to provide maximum confidence in the adaptive capacity assessment. There are opportunities to continue to build and review the model to incorporate further socio-economic information to strengthen understanding and measurement of resilience in regional areas.

The average score across indicators gave an overall drought index of 3.3 for the Mid West region, indicating considerable vulnerability to drought, supporting the vulnerability mapping. Due to the degree of variation between indicators it is important to consider them individually (Table 2). Areas of strength in drought resilience which should be maintained and developed are the region's good soil capability and low production risk. Weaker areas in terms of drought resilience include expected impacts of climate change on temperature and rainfall patterns, increasing drought frequency, NDVI trends and the level of direct dependence of local economies and livelihoods on agriculture.

Results

Drought vulnerability in the Mid West region is a function of three major drivers:

- **Exposed areas** – show long-term increases in temperature and decreases in rainfall, decline in growing season rainfall, measurable increases in drought frequency, and measurable declines in potential wheat yield and root zone soil moisture.
- **Sensitive areas** – exhibit low farm profits, low vegetation cover, low water asset count, high levels of economic dependence on agriculture, and demographic factors such as lower household income and relative remoteness.
- **Areas with low adaptive capacity** – have relatively poor access to water infrastructure, high unemployment, a large percentage of the population over 65 years of age, and reliance on degraded or poorer quality natural resources, including water and native vegetation.

The area of strength and resilience, which should be maintained and built upon, is the region's production capability. Specific exposure, sensitivity and adaptive capacity maps and assessments are presented in the Mid West DVA.

The final drought vulnerability maps (Figures 11 and 12) are a composite of adaptive capacity and drought impact, and show that the Mid West region is highly to very highly vulnerable to drought, with highest vulnerability in the north and east. The drought vulnerability maps can be used as a decision-support tool to link priority areas to implementation activities developed through stakeholder engagement.

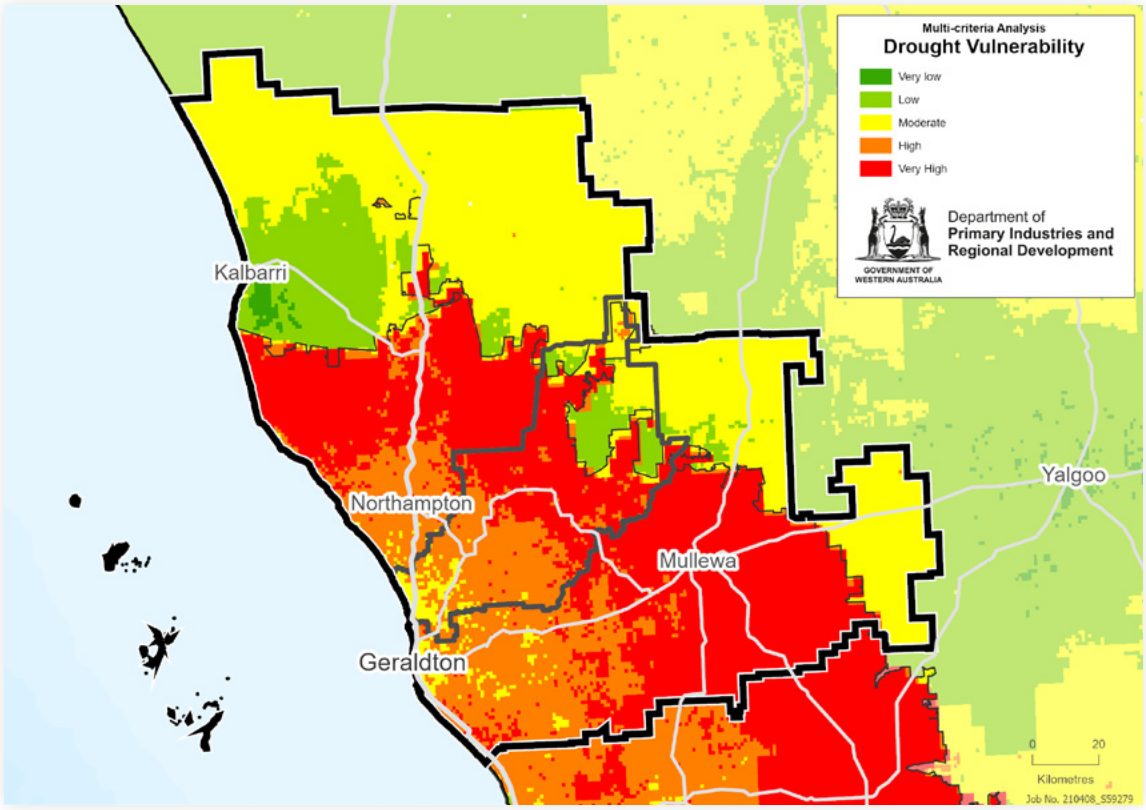


Figure 11: Final drought vulnerability map for South West Land Division of Western Australia showing areas most vulnerable to drought are in the north and east of the region.

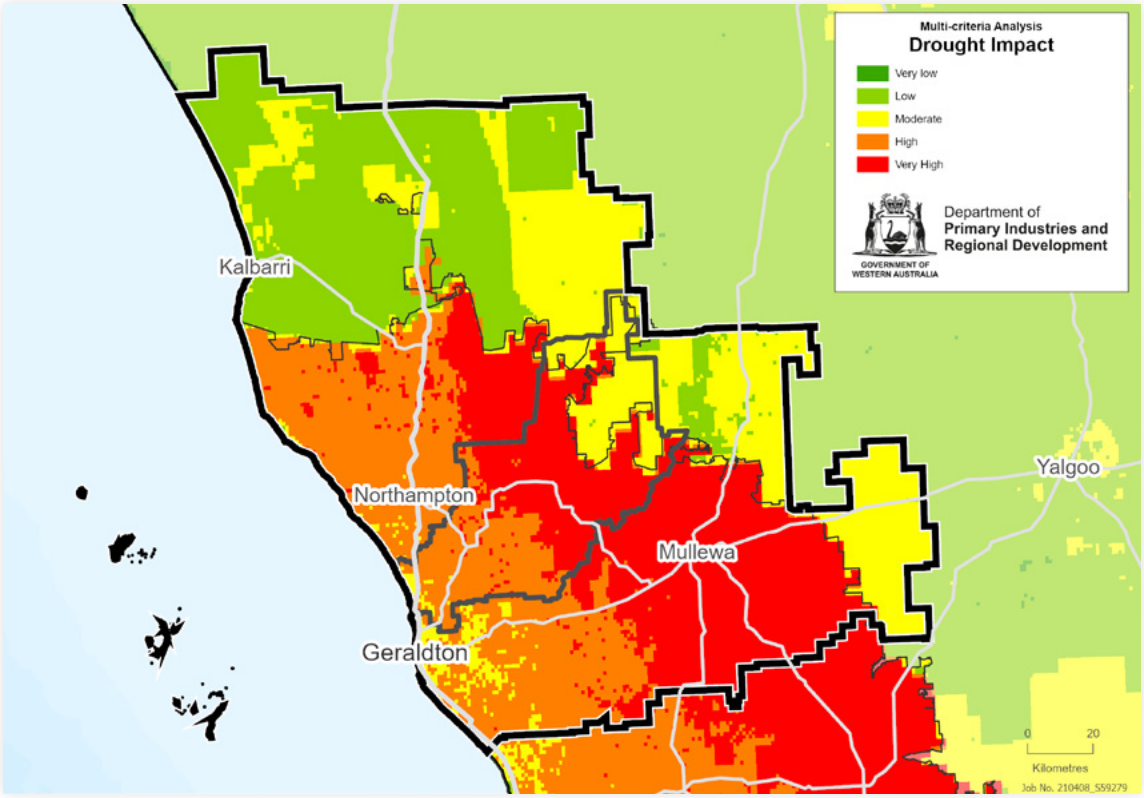


Figure 12: Final drought vulnerability map at Mid West region scale. The map highlights drought risk priority areas based on temperature, rainfall and production data, access to infrastructure, population demographics and environmental characteristics. Data for pastoral areas in the far north and east are not reliable and should be ignored.

Table 2. Indicators used as proxies for exposure, sensitivity and adaptive capacity to calculate an index of vulnerability for the Mid West region.

Component	Indicator	Score
Exposure	Projected change in growing season rainfall and maturing season temperature	4
	Change in timing of the autumn break to date	3
	Change in drought frequency to date	5
Sensitivity	Production risk (crop and livestock combined)	2
	Trend in NDVI (lowest 10%)	4
	Percentage employment in agriculture	4
Adaptive capacity	Percentage unemployment	3
	Access to infrastructure	3
	Groundwater quality	3
	Soil capability	2
INDEX		3.3

It proved difficult to correlate and predict the severity of social and economic impacts to driving conditions of drought (such as low rainfall, high temperature and low soil moisture). Further work is required to understand these relationships, and the links between social and economic impacts and environmental and economic predictors in the context of drought.

Impacts of drought

The impacts of drought in the Mid West regions are cross-cutting. Stakeholder engagement revealed drought impacts can be significant and wide ranging affecting the economic, social and environmental functioning of the region's communities, landscapes and businesses. Almost the entire agricultural portion of the Mid West study region has high and very high likelihood of being impacted adversely by drought (Figure 13). A summary of the main impacts of drought in the Mid West region, identified through the stakeholder engagement and technical review process, are outlined below.

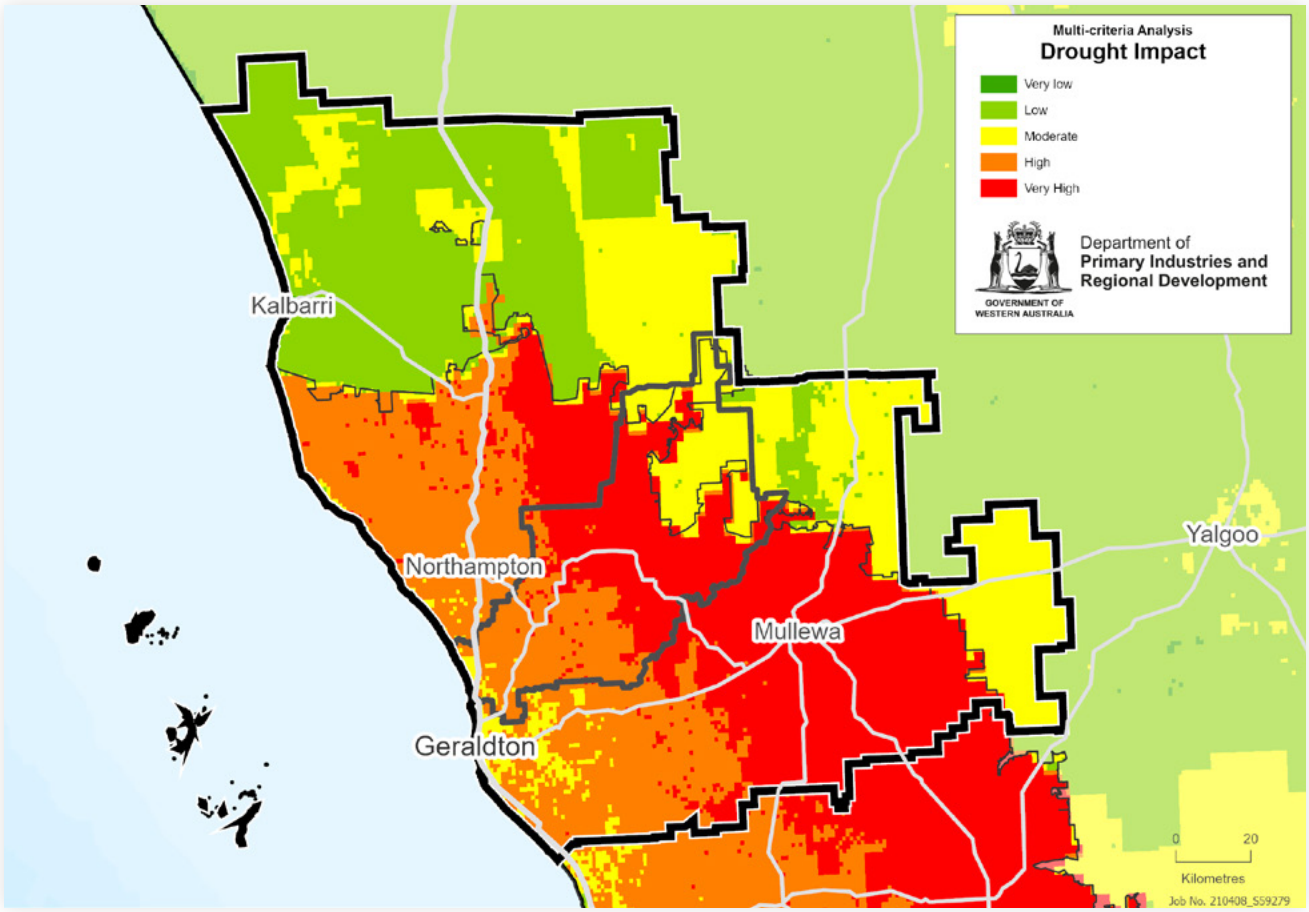


Figure 13: Drought impact in the Mid West region.

Economic Impacts

Rural communities in the Mid West region have a low level of economic diversity. Aside from the regional centre of Geraldton, they are dependent on the agriculture sector for their economic well-being. The reliance on agriculture means that droughts impact negatively on the economic and social well-being of these communities. During the consultation process, the most frequently mentioned impact of drought identified by Mid West stakeholders was serious financial stress.

The most obvious economic impact of drought is on the volume of agricultural production. Compromised production has large effects on household income, which can lead to long-term financial hardship, deterioration in household financial positions and knock-on effects on regional employment. Farmers and growers may have to use equity, increase debt or seek off-farm income. Negative impacts can linger for many years due to the depletion of farm capital during drought years. While there is an overall increasing trend in operating surplus for agricultural businesses in WA, low operating surpluses are evident during drought years, with surpluses tending to drop below $50 per hectare in low rainfall areas. Farms in the Mid West region are in the near-lowest farm business profit percentile range.

Although droughts cause financial pain, farmers have, on average, been able to manage their businesses such that their wealth improves. This has been achieved by increasing farm size, altering farming systems towards greater cropping and increasing production efficiency to create additional profit. Additional factors that make farmers and communities more resilient to drought include access to water and good infrastructure, low debt levels, low interest rates, high commodity prices, efficient production, diversification, populated communities and a fast, reliable internet connection.

The impacts of drought are often highly farm specific. Financial ramifications can be different in different years and different businesses can be differently affected. Identifying the real impact of drought conditions can be difficult using aggregated data. An analysis of the current performance of 36 farm businesses in the Mid West region compared their performance in 2006/07 and a more recent poor season in 2019.

The analysis found that most farming businesses in the cohort are moderately to strongly resilient, with all still trading after both drought events. The most resilient and likely to survive consecutive future droughts are generational businesses with accrued wealth and a demonstrated ability to generate profit, and reinvest into the business. These businesses are large scale, in terms of both gross income and effective hectares, and have a low representation of livestock as part of the business.

The least resilient, particularly in the event of consecutive future droughts, are start-up business with no generational wealth and or located in the low rainfall zone. Many have experienced financial shocks in recent years, such as succession issues. Almost all are smaller than average in terms of gross income and/or effective hectares, and have lower than average investment in plant and equipment. Their survival in the event of successive drought years will depend on their ability to minimise losses, source finance to continue trading and improve profits in subsequent years.

Given recent increases in the costs of operating, the risks due to a poor season are greater today than in the past. While recent increases in land values provide increased equity for those that already own their land, high prices can stifle growth aspirations or increase risk related to servicing debt for newer or smaller enterprises.

For more information on the economic impacts of drought in the Mid West region refer to the Mid West DVA and accompanying appendices.

Environmental Impacts

Regional communities are dependent on natural resources for their livelihoods, with ecosystems providing important services to agricultural production, biodiversity and public amenity. Environmental impacts can be widespread and long-lasting, contributing to land degradation processes, and are among the most noticeable effects of drought. During the consultation process, Mid West stakeholders stated that drought negatively affected soil health, water resources (natural and scheme) and biodiversity. Several noted the terrible soil erosion which occurred in the 2006/07 drought as well as the bare and brown landscapes, and increased fire risk. Aboriginal community members in the Mid West were extremely concerned about the impacts of drought on biodiversity and bushfire regimes. During the 2006-07 drought, Aboriginal landholders also experienced land degradation, and water supply and quality problems.

Drought conditions have significant impacts on natural resources, including irreversible damage to water quality, soil and vegetation, leading in turn to dust storms and a loss of topsoil, soil nutrients, organic matter and soil carbon. Annual environmental condition scores for the Mid West region from 2000 to 2021 utilising inundation, streamflow, vegetation growth, leaf area, exposed soil, tree cover, and number of hot days were lowest in 2007, 2013 and 2019, reflecting drought and poor season conditions. The effects of drought on the environment persist and are detectable in environmental condition scores for several years after the event.

The Mid West region relies predominantly on groundwater aquifers for its water resources. As aquifers are recharged by rainfall, they are highly susceptible to drought and declining rainfall. When annual rainfall totals less than 300mm, little to no groundwater recharge occurs. Average annual rainfall for the Mid West region between 1980 and 2020 was 254mm. Over this period, rainfall above 300mm occurred in only nine of the 41 years. As such, aquifer water levels are falling and water quality declining. Requests for large volumes of water for new developments cannot be accommodated. A rising trend in salinity indicates changing aquifer conditions. Scheme water is considered too poor in quality for horticultural production. The region's horticultural producers blend scheme water with rainwater or treated waste water which is fresher than groundwater.

Healthy ecosystems build resilience to drought, and nature-based solutions can offer cost-effective protections while delivering co-benefits such as carbon capture and storage, and improved food and water security. Sustainable natural resource management, including of soil, water and biodiversity, must be prioritised.

For more information on the environmental impacts of drought in the Mid West region refer to the Mid West DVA and accompanying appendices.

Social Impacts

The immediate and medium-term, direct and indirect social impacts of drought are diverse, related to employment, education, migration, family relationships, mistrust of government, uncertainty over the future and over community resources and support systems. All these factors have the potential to directly or indirectly impact on physical, mental, social and emotional health and wellbeing.

During the consultation process, Mid West stakeholders stated that drought negatively affected their mental health. It contributed to failed businesses, to people moving away, and to a reduction of skills and services in the region. Drought strained community services and support networks. While communities came together to support each other, the burden of organising events and coordinating groups falls to the same people, also struggling through drought. Off-farm work was viewed as important for mental health but not as financially worthwhile.

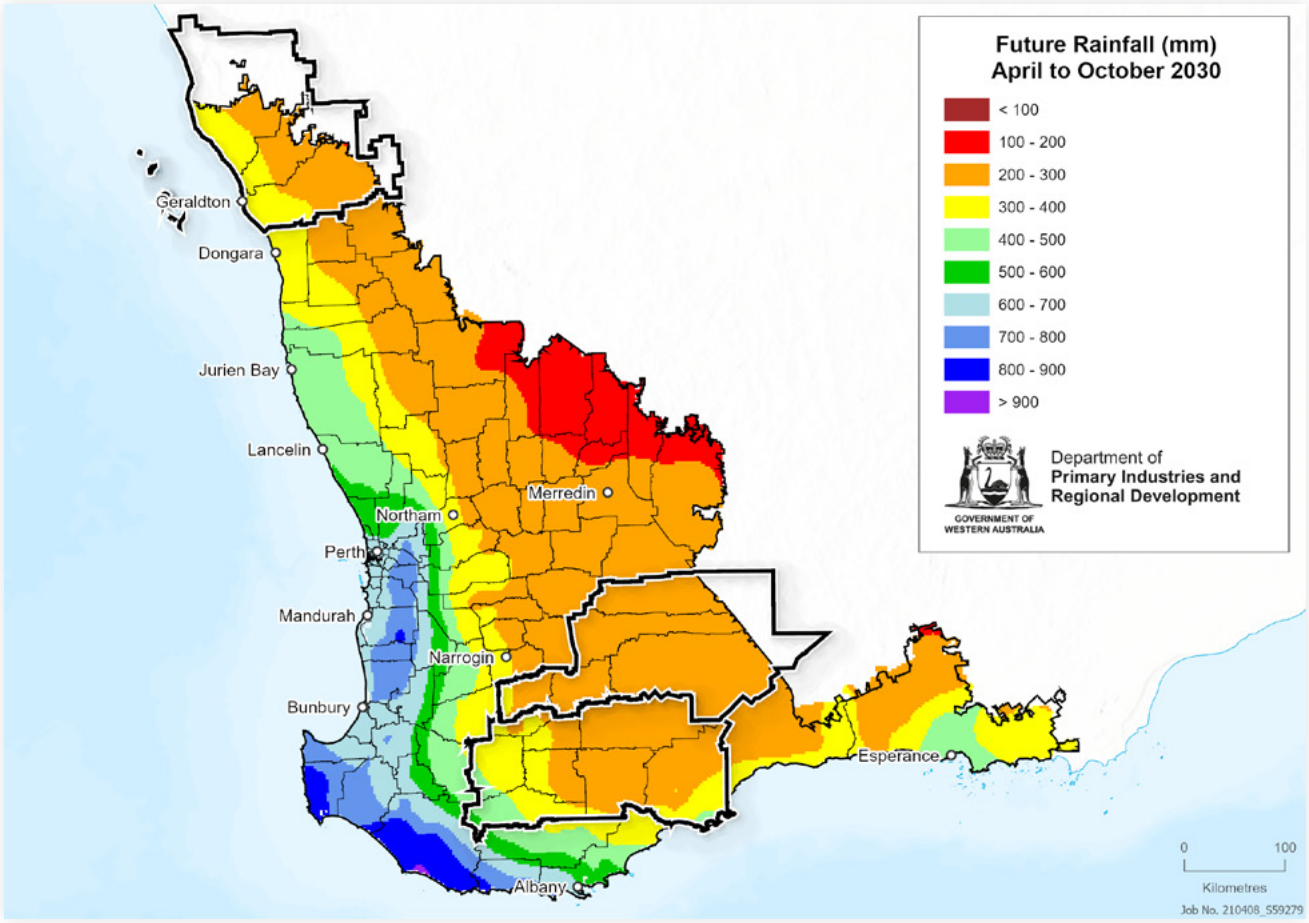
Aboriginal communities are likely to be disproportionately affected by drought based on pre-existing health and social disadvantage. Prolonged drought impacts on rural and regional employment opportunities and degrades the environment. This can affect Aboriginal peoples' ability to carry out cultural roles that support cultural identity. Barriers to Caring for Country impact on mental, emotional and physical wellbeing. During prolonged drought, Aboriginal people can experience solastalgia, a feeling of psychological desolation caused by the recognition that one's home is under physical threat and eroding one's sense of belonging.

Building resilience to the impacts of drought involves taking action at both the individual and community level, with many non-farming people and businesses also impacted by the loss of income and regional outmigration associated with drought. Mid West stakeholders highlighted the need for stronger support to community groups and networks during drought.

For more information on the social impacts of drought in the Mid West region refer to the Mid West DVA and accompanying appendices.

Future Scenarios

As the climate changes, the Mid West region will continue to see increasing temperatures and reduced growing season rainfall (Figure 14). The time spent in meteorological drought will increase over the course of the century. The recent increasing prevalence of hot drought (combined high temperatures and low rainfall) (Figure 15) is alarming. The impacts of hot drought will be devastating, and likely to occur more frequently and over larger areas.



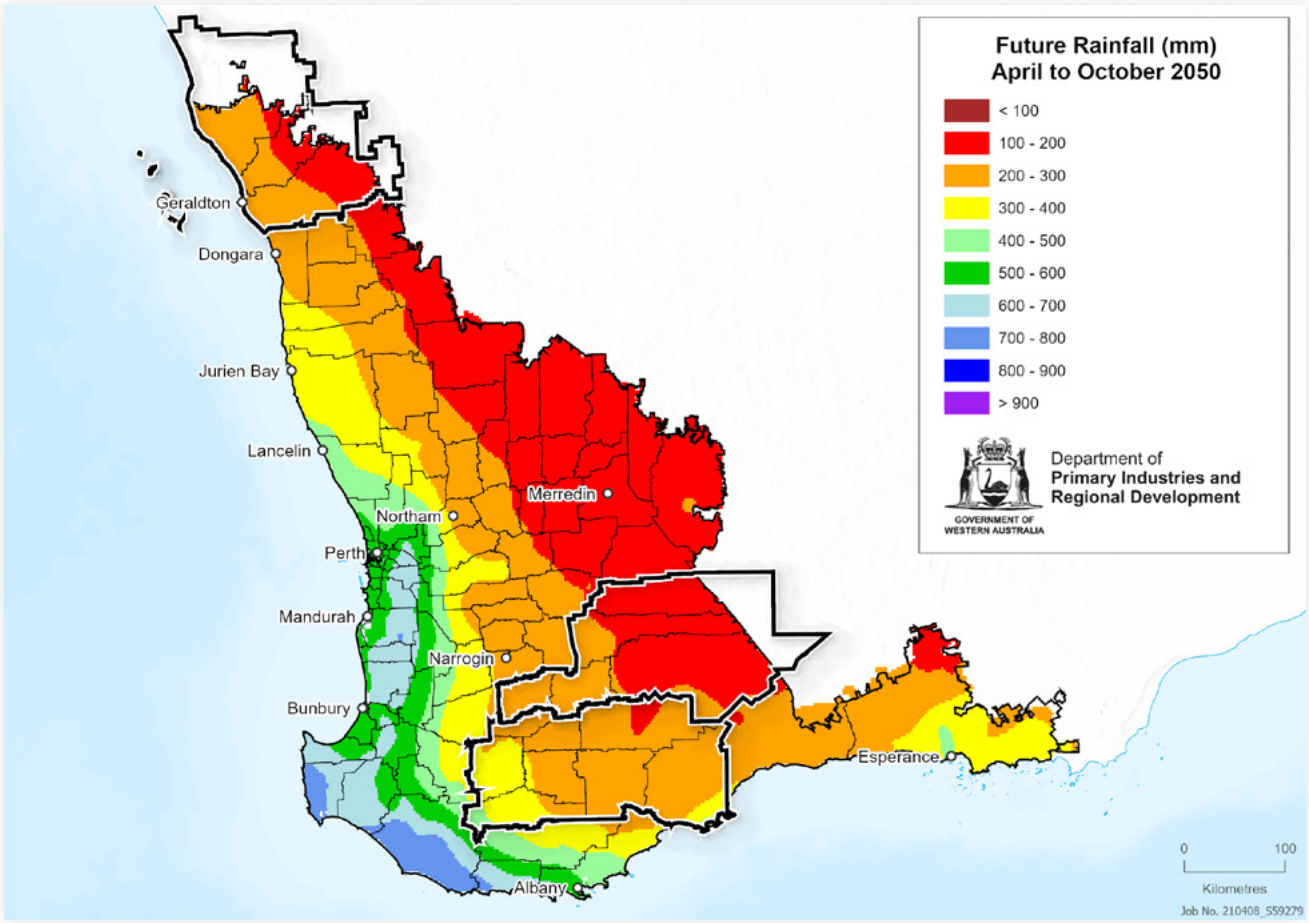


Figure 14: Maps showing the projected rainfall during the growing season of April to October by 2030 (left) and by 2050 (right).

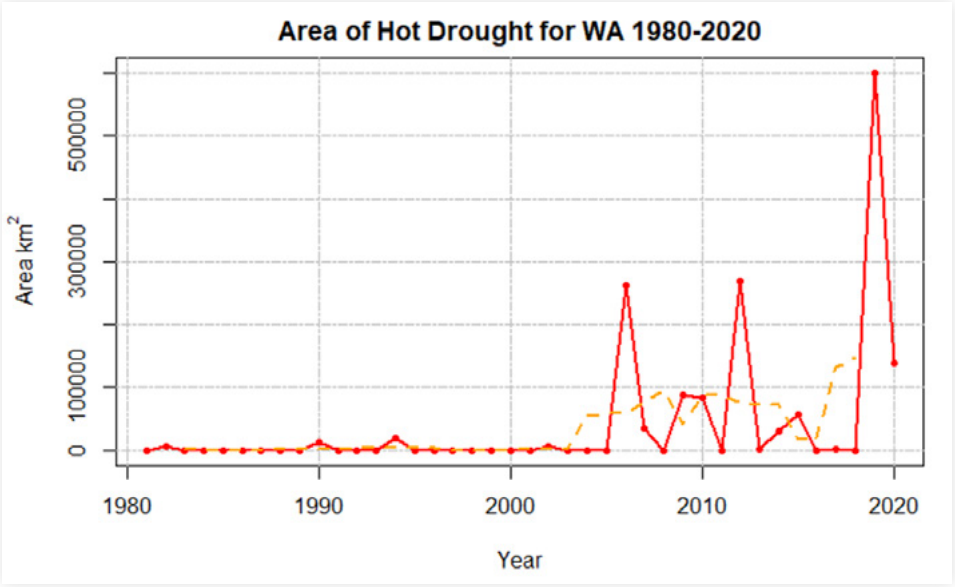


Figure 15. Area (km²) of hot drought across Western Australia 1980 to 2020 (solid red line), and a five-year running average (dashed orange line).

Broadacre crop and pasture production are more likely to decline in drier, warmer northern and eastern areas of the South West Land Division such as the Mid West region. Average potential yield has already declined dramatically across the Mid West as a result of increasing temperature and increased evapotranspiration.

Livestock welfare risks may increase as higher temperatures reduce the availability of feed and increase heat stress. Higher temperatures may also affect livestock productivity by reducing reproductive rates, growth rates and milk production.

The amount and quality of water available for horticulture and other agricultural activities will continue to be affected by reduced recharge to aquifers. Water resources potentially may not be able to meet residential and commercial demand, nor environmental needs.

While dryland salinity is likely to reduce due to declining rainfall, wind erosion may increase due to decreasing groundcover and water erosion due to increasing summer rainfall. Erosion is one of the greatest risks to soil health during drought, as it strips away the fertile top layers of soil and organic matter. Further, reduced rainfall and higher temperatures dry out soil, creating cracks that reduce the moisture and volume of the soil, affect the activity of soil microbes, reduce soil particle cohesion, change soil texture, decrease soil water holding capacity and limiting plant growth.

As the climate becomes more inhospitable for both native vegetation and crops, insects, feral animals, and weeds may increase in prevalence, creating further damage to native vegetation and biodiversity more broadly, as well as crops.

Projected increases in other extreme events such as cyclones and floods could exacerbate the social, economic and environmental impacts of future drought.

Farmers are achieving returns from seasons that would have been loss-makers a decade ago, and achieve returns on both good and marginal land. However, continued dependence on the export market, increases in the costs of doing business and rising rural debt may leave farming households more vulnerable to economic impacts of future drought, particularly if droughts span multiple consecutive years.

The Mid West DVA and associated appendices describe future drought scenarios and vulnerability of the region to future climate impacts in more detail.

As part of the transformative review process (Appendix 1) mega-trends were identified which have and will continue to have impacts on agricultural businesses, communities and environments, and which will drive future changes and adaptations in the three WA RDRP regions (Table 3). These mega trends and drivers must also be used to inform future drought resilience actions in the Mid West region.

Table 3. Mega trends in the agricultural systems and communities of the three WA RDRP regions and their resultant impacts and drivers of change.

Mega Trend	Impact	Driver
Supply and Demand Shocks	High input costs, substitution inputs, tight supply commodities, confidence in agricultural industry, land value increases	Supply chain disruptions
Food Trends	Vegetable oil and plant protein demand, aquaculture product demand, onshoring meat production	Demand for vegetable oil, plant protein and seafood
Climate Crisis	Need for adaptive responses, ecosystem services, natural capital market, carbon market opportunities	Net zero transition, decarbonising economy
Resource Scarcity	Oil, gas, water, labour underpinning inputs for regions' economies	Water, energy, labour key drivers
Digital Transformation	Connectivity is the new highway, and data is currency	Connectivity and digitisation of industries and communities
Neo-ecology	Sustainability becoming major economic driver	Sustainability credentials for trade and markets
Globalisation and Pandemics	Less safe world, which is very connected, ongoing impact from major events + tensions	Biosecurity
Wellbeing	Wellbeing of communities impacted by drought	Building community cohesion

Current responses to drought and dry seasons

Mid West community consultation emphasised a preference for hand-ups over hand-outs to mitigate drought impacts. Local growers are proactive in taking existing knowledge, opportunities and technologies to make their businesses and themselves more resilient to drought. Community consultation also highlighted the desire of growers to learn from each other, and for knowledge and experiences to be shared between groups and regions.

As such, several growers agreed to participate in extended interviews, conducted as part of the stakeholder consultation process, outlining their current drought mitigation actions, and for these to be shared. Excerpts from the interview write ups highlighting different areas of drought mitigation are presented below. Links to each full write up are provided.

Business Planning

Steve Rowe, Wongoondy, City of Greater Geraldton

A key strategy for Steve has been spreading the geographic risk of drought. After the major drought of 2006/2007, he purchased two properties which are approximately 25km from his other three adjoining properties. Steve also believes in being in as good a financial position as possible, including managing debt and having off-farm investments and assets as back-ups to withstand drought.

Education and Training

Bao Duy Nguyen, Deepdale and Walkaway, City of Greater Geraldton

Bao Duy was awarded the prestigious Nuffield scholarship in 2016, allowing him to learn more about new horticultural practices to improve and expand the business. He travelled to over 10 countries between 2017-2019, gaining valuable knowledge in low technology greenhouses, and horticultural practices.

Soil Health

Ben and Ange Cripps, Ogilvie, Shire of Northampton

Ben and Ange's land management practices include liming, controlled traffic, stubble retention, fallowing paddocks and summer weed control. Fallowing and controlling summer weeds increase soil moisture, and liming ensures crops have access to that stored moisture. Without liming crop roots would hit a shallow acidic barrier.

Perennial Pasture

Lloyd Cripps, West Binnu, Shire of Northampton

The Cripps' started sowing perennial grasses after the major 2006/2007 drought. They have established 350ha on which they have intense grazing periods followed by long rest breaks. As a result, they have reduced wind erosion and have a reliable feed source in summer and autumn.

Stock Management

Daniel Gill, Sandy Gully, Shire of Northampton

Daniel has a drought plan for his sheep too. By pregnancy scanning his ewes, Daniel can divide the dry, single-pregnancy and multiple-pregnancy ewes into separate mobs. He puts more energy into the ewes carrying multiple lambs and can easily sell off the dry ewes if there is no rain by June.

Climatic Triggers

David Tropiano, Mullewa, City of Greater Geraldton

Being efficient also involves being prepared to seed and control summer weeds as soon as conditions are favourable. The Tropiano family have always dry-sown but are more aggressive with it now, focusing on definitive end dates for sowing, not start dates. These approaches make the most of and preserve soil moisture.

THE PLAN

While the Mid West RDRP and DVA identify reinforce the high level of proactivity of growers and communities to drought preparedness, they also highlight that further preparedness is required to continue to address current and future impacts of drought, and associated climate change trends.

The Mid West community and technical stakeholders, and the transformative review (Appendix 1) identified actions for the Mid West which are required to meet key Mid West priorities (Figure 5) as well as drought and climate change resilience more broadly.

The Mid West actions encompass aspects of maintenance, modification, or transformation of parts, sectors or whole systems at the local, regional and state level.

The Mid West actions are presented in this Plan. They are grouped under each of the FDF strategic priorities of social resilience, environmental resilience, and economic resilience, and their supporting FDF objectives. They are presented against the Drought Resilience Funding Plan 2020-2024 actions to show the high level of concord with these, as well as the Mid West community priorities where actions came from community consultation. The order in which the Mid West actions are listed does not imply any sort of ranking of importance.

Many programs relevant to the implementation of the Mid West actions already exist. Some are identified below and many in the transformative review (Appendix 1) but there will be more which have not as yet been identified. This identification process will form part of the implementation plan.

PLAN IMPLEMENTATION AND ENDURING GOVERNANCE

The Mid West RDRP's proposed priorities and actions have been developed with the community and technical experts, and independent transformative review. Delivery and impact is targeted at the local and regional level, with some interventions having significance beyond the Mid West region. We acknowledge there are many relevant programs already underway or being planned that will support the delivery of the Mid West RDRP, and to the best of our knowledge, we have engaged with those programs.

The implementation of the Mid West RDRP, including identification of priority program areas and the plan's enduring governance and ongoing resourcing, will be subject to further discussion in coming months with participating LGAs and potential program delivery partners, including the South West WA Drought Resilience Adoption and Innovation Hub. While locally-led delivery of the Mid West RDRP is preferred to ensure maximum community buy in and impact, resourcing to implement the plan requires resolution.

This work will also consider the principles of the feasibility and practicality of proposed actions and the quantitative and qualitative public-good benefits to the region as described in Component 8 of the *Regional Drought Resilience Plans Independent Review Guide*.

FDF STRATEGIC PRIORITY: SOCIAL RESILIENCE

FDF Objective: Enhance the public good by building drought resilience through programs that maintain and improve the wellbeing and social fabric of rural and regional communities.

Current Situation

People of the Mid West region feel stressed in times of drought. While groups, networks and communities draw together in solidarity, volunteers and leaders feel overworked and overwhelmed. This is compounded by people and services leaving communities during drought, and a lack of support or lack of knowledge of available support.

The top ranked priorities for social resilience identified from public consultation were:

Technical consultation also identified the need to capture suitable data on the social effects of drought as well as the effectiveness of social and mental health interventions during drought.

Mid West RDRP actions	Action source			Community priority
	Public consultation	Technical consultation	Transformative review	
Information and planning				
• Develop a socially-focused drought resilience framework to assess the impacts of drought and ground-truth its applicability		X		
• Evaluate current support programs and review demands for mental health services to help ensure adequate support for rural and regional communities in drought	X	X	X	*Health*
• Assess learnings from the Cyclone Seroja recovery model and use these to develop a program to service communities affected by drought	X	X		*Towns*
• Increase the visibility and knowledge of available support mechanisms (on-line platform / information packages / publicity campaign)	X	X		*Health*
Collaboration and building capability				
• Funded administrative support positions hosted by local agencies shared between local volunteer/ grower/biosecurity groups to reduce burnout, particularly during adverse events such as drought	X		X	*Groups*
• Funding for community events and clubs to improve well-being and mental health resilience to cope with drought events and declining rainfall trends (including arts, culture, exercise programs, sports clubs, social events)	X		X	*Health*
• Support the capture and peer-to-peer sharing of drought resilience success stories by growers and community leaders which demonstrate the adoption of effective on-ground works and appropriate innovation options which increase drought resilience	X	X	X	*Health*
• Expand the Rural Leadership Program to increase local leadership and mentoring opportunities in drought affected communities, including the connections between generations to share drought solutions/support and improve youth participation in drought preparedness	X		X	*Groups*
• Expand existing community infrastructure and resources to act as mini innovation hubs where people can develop and test drought resilience ideas	X		X	*Groups*
• Implement a marketing campaign focused on the positives of rural and regional living and lifestyle, career opportunities aiming to increase rural populations	X			*Groups*
• Develop incentives to attract and retain skilled professionals into rural and regional areas to stem decreasing rural services during drought	X		X	*Towns*
• Identify barriers to utilising local, vacant housing stock to improve housing affordability, provide temporary worker accommodation, assist homelessness problems and retain rural populations, particularly during drought	X		X	*Towns*
• Identify opportunities and incentives for local rural farms and businesses to retain staff during times of drought (Drought Job Keeper)	X			*Towns*

Mid West RDRP actions	Action source			Community priority
	Public consultation	Technical consultation	Transformative review	
Community facilities and infrastructure				
• Develop and or maintain drought tolerant/resilient green spaces to support well-being during drought (community gardens, town ovals, water parks)	X	X	X	*Health*
• Support for the implementation of town planning strategies to make towns more attractive	X	X		*Towns*
• Examine opportunities and current barriers to increasing water reuse in Geraldton and examine opportunities in smaller towns with reticulated sewerage, e.g. Horrocks	X		X	*Towns*
• Conduct a cost/ benefit analysis of stormwater harvesting opportunities throughout major towns in the Mid West region		X		
• Identify options to upgrade or establish new on-farm or community water supplies and seek funding at individual or collective scale		X	X	*Towns*
• Examine and trial technological solutions to provide a cost effective and sustainable options for small-scale desalination of water including waste disposal (supplies at farm or community scale)	X	X	X	*Towns*

Drought Resilience Funding Plan 2020 to 2024 actions

Information and planning

- Support data and information collection, coordination and supply to improve community and regional planning to build drought resilience
- Empower communities to identify the impacts of drought and develop regional drought resilience and management plans
- Assist communities to develop and implement innovative activities that build drought resilience

Collaboration and building capability

- Facilitate increased community understanding of their drought resilience, including through training and information sharing—for example, case studies, inventory or support packages and making information readily accessible
- Encourage communities with a high level of drought resilience to share learnings with other communities
- Support community activities and initiatives that foster ongoing social networking, support, engagement and wellbeing
- Encourage the development of local leaders, including youth, to enhance wellbeing and drive initiatives that build drought resilience
- Support initiatives that strengthen and build leadership in communities to help build drought resilience, including exploring entrepreneurial opportunities

Community facilities and infrastructure

- Support communities to implement small-scale enduring infrastructure projects to build drought resilience and enhance wellbeing—such as water efficient or recycling infrastructure for sporting and recreational facilities, upgrades to public gardens, tourist attractions and other community facilities

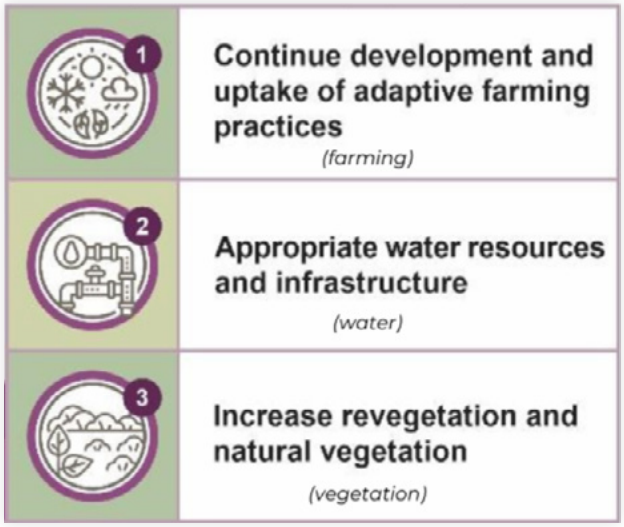
FDF STRATEGIC PRIORITY: ENVIRONMENTAL RESILIENCE

FDF Objective: Enhance the public good by building drought resilience through programs that improve the natural resource management of agricultural landscapes.

Current Situation

The Mid West region comprises of highly modified environments, many on the vulnerable northeast margins of the agricultural zone. It has been subject to several serious droughts, such as that of 2006-2007. Growers and local communities have, and continue to, adapt to changes in climatic conditions and prioritise the protection of environmental resources both agricultural and natural to mitigate the impacts of drought.

The top ranked priorities for environmental resilience identified from community consultation were:



Technical consultation also highlighted the need for regional biodiversity inventories, the identification of marginally productive or unproductive land and soils, and data on the value of ecosystem services.

Mid West RDRP actions	Action source			Community priority
	Public consultation	Technical consultation	Transformative review	
Knowledge, innovation and extension				
• Quantify the economic and social value of regional ecosystem services to allow for better farm resource and business planning		X		
• Support landholders to adopt and implement ecosystem services standards and measurement tools as they evolve	X			*Farming*
• Conduct local inventories of biodiversity on both private and public lands, including the current state across a range of parameters such as species present, native vegetation condition, weed and feral animal incursions etc.		X		
• Monitor and record the short- and long-term impacts of drought on natural resources in the Mid West		X		
• Monitor and evaluate current NRM interventions in the Mid West and provide feedback on the effectiveness of these	X	X		*Vegetation*
• Conduct soil mapping at the regional and farm scale, and distribute to growers to better inform on-farm improvement of soil health and land use planning	X	X		*Farming*
• Conduct hydrological mapping at the regional and farm scale, and distribute to growers to better inform on-farm planning for efficient use of soil moisture and water resources	X	X		*Water*
• Coordinate and manage soil sensor data across multiple farms, including the delivery of information back to growers, to better manage soil resources and land planning	X			*Farming*
• Expand the UWA flux tower network and associated recharge monitoring sites to the Mid West to better understand landscape dynamics, and use the data to further inform water resource management, NRM strategies and adaptive farming practices, and future carbon market projects		X		
• Identify marginal land at the regional and local scale unsuitable for agriculture to assist with identifying alternative uses and or planned retreat	X	X		*Vegetation*
• Undertake hydrogeological investigations in the Tumblagooda aquifer to support growth and drought resilience for the Northampton area	X	X	X	*Water*
• Implement 'water farming' trials in geologically appropriate areas whereby land use is managed to facilitate maximum recharge of groundwater at a local scale	X			
• Increase funding to local biosecurity groups for pest, weed and feral animal control, incentivising the use of new technologies (e.g. drones)	X	X		*Farming*
• Promote the continued uptake of precision agriculture practices and technologies (e.g. VRT, seed and spray, 'green or green') through education, case studies and demonstration programs, and financial incentives	X		X	*Farming*

Mid West RDRP actions	Action source			Community priority
	Public consultation	Technical consultation	Transformative review	
Knowledge, innovation and extension (continued)				
• Promote the continued uptake of soil erosion control measures such as perennial pastures and native windrow plantings (e.g. expand the Growing Great Ground program) through demonstrations and increased financial incentives	X	X	X	*Farming*
• Promote the continued uptake of practices which improve soil health (e.g. amelioration, liming, strip and disc, chemical fallow) through education, case studies and demonstration programs, and financial incentives	X	X	X	*Farming*
• Support and contribute to continued research and demonstration projects into regenerative agricultural practices to promote the uptake of practices beneficial to environmental resilience	X	X	X	*Farming*
• Support collaborations between grower groups and research institutions for the continued development of drought resistant breeds and crop varieties, as well as alternative crops	X	X	X	*Farming*
• Continue research and development into alternative stock feeds (e.g. Asparagopsis) to improve stock management	X		X	*Farming*
• Continue research and development with local horticulturalists into the production, application and benefits of biochar	X		X	*Farming*
Collaboration and building capability				
• Identify marginal agricultural land and subsequent options to incorporate carbon farming across multiple farming properties for regional scale carbon projects	X	X	X	*Farming*
• Coordinate and improve water catchment planning to better support landscape scale actions which protect waterways	X	X		*Water*
• Expand the Chapman Catchment project demonstration sites for earthworks for rehydrating landscapes and build related extension and training programs	X		X	*Farming*
• Expand Aboriginal participation (e.g. ranger programs) on both public and private land to manage natural resources (e.g. fire management)	X			*Vegetation*
• Collaborate with Aboriginal groups to preserve and expand remnant native vegetation, as well as manage threats to biodiversity	X			*Vegetation*
• Support improved technologies for the Geraldton horticultural sector to reduce inputs and water use, including irrigation options linked to domestic water reuse	X	X		*Water*
• Provide financial support to accelerate feasibility and planning for a new desalination water source to support growth and drought resilience in the Mid West region. This will inform decision making and provide greater clarity for the future of the region	X	X	X	*Water*
• Understand barriers to increasing water efficiency (in new and retrofit builds), implement better urban water management principles and advocate for stronger mechanisms for decision making authorities to require greater water efficiency		X		

Mid West RDRP actions	Action source			Community priority
	Public consultation	Technical consultation	Transformative review	
Natural capital and commercial opportunities				
• Promote and facilitate collaboration between local private industry and land holders to revegetate marginal land for new carbon market opportunities or offsets	X	X		*Vegetation*
• Develop and promote businesses (e.g. nurseries, native seed supplies, bush foods) which support NRM activities as well as provide income diversification for land holders and Aboriginal groups	X	X	X	*Vegetation*
• Support land managers to use available industry approved tools to calculate the carbon 'footprint' of their businesses, and to make subsequent management decisions to mitigate the impacts of drought on environmental and economic assets	X	X		*Farming*
Drought Resilience Funding Plan 2020 to 2024 actions				
Knowledge, innovation and extension				
• Improve information and management capacity for farming practices and systems that support improved functioning of agricultural landscapes				
• Facilitate primary producers' increased knowledge of market and private sector services to improve natural resource management and enable access to emerging markets				
• Support the collection, management, public accessibility and application of data and information to improve natural resource management				
• Support the development of systems and collaborations that enable better analysis and practical application of data, including for farm natural resource management practices				
• Involve end users to co-design local natural resource management research development, extension and adoption. This will help to develop tailored outcomes and the adoption of the research				
• Support incentives for practice change that will build or redesign landscapes for improved functioning. Support primary producers to adopt strategies for improving soil health, land cover, water and biodiversity				
Collaboration and building capability				
• Encourage improved natural resource management capability through planning and training on financial, drought and risk management				
• Support on-ground projects that enhance the resilience of natural capital in agricultural landscapes—including adoption of new or existing technology and practices				
• Incentivise local and regional organisation's capabilities by trialling and adopting new natural resource management practices and technology through collaboration				
• Support landholders to undertake voluntary environmental resilience assessments or other measures to better understand their environmental resilience level				
Natural capital and commercial opportunities				
• Promote the development and adoption of new or existing commercial opportunities and technologies that support improvement of natural resource condition and resilience				
• Support the creation and uptake of commercial opportunities for investment into sustainable landscapes, and encourage increased private sector's involvement in environmental management				

FDF STRATEGIC PRIORITY: ECONOMIC RESILIENCE

FDF Objective: Enhance the public good by building drought resilience through programs that will grow the self-reliance and performance (productivity and profitability) of the agricultural sector.

Current Situation

Many Mid West farm businesses have improved their economic preparedness and performance through planning and adapting but financial stress for farmers and rural communities during drought remains high. Dependence on export markets, changing climatic conditions, rising rural debt and costs, and the pilot region's high dependence on the agricultural sector, make farm businesses vulnerable.

The top ranked priorities for economic resilience identified from community consultation were:

Technical consultation also highlighted the need to develop appropriate measures of farm economic resilience, and to gather this data consistently and broadly.

Mid West RDRP actions	Action source			Community priority
	Public consultation	Technical consultation	Transformative review	
Knowledge, innovation and extension				
• Using effective and modern communication tools such as short videos, animated infographics and podcasts, build community understanding of new weather, climate and water science information that is coordinated, easily accessible and engaging	X	X	X	*Triggers*
• Develop an appropriate drought criterion for Western Australia, taking into consideration use of seasonal rainfall versus the current meteorological definition using annual rainfall	X	X		*Triggers*
• Undertake further research into the emerging trend of 'hot droughts' including modelling on current and predicted future impacts on agricultural assets and production		X		
• Develop, refine and ground truth regional drought indices to assist with drought responses, planning and decision making in the region	X	X		*Triggers*
• Refine and ground truth the drought vulnerability assessment framework for the Mid West to better identify the most at risk areas		X		*Triggers*
• Support initiatives to build regional climate monitoring capacity, networks and data sharing	X	X		*Triggers*
• Develop a long-term monitoring program of the economic performance of several WA farms, encompassing a range of sizes and production types, to assist with informed drought policy decisions at a regional and state level		X		*Triggers*
• Review and collect suitable data through recognised sources to track farm business, and rural and regional business performance and response to drought to inform drought policy and response		X		
• Develop and promote an easy-to-use online platform which provides drought definitions, forecasts, monitoring initiatives and decision making tools for land holders (e.g. The Long Paddock website, QLD)	X			*Triggers*
Collaboration and building capability				
• Develop and deliver capability-building programs to improve farm business skills and decision making, including financial literacy and planning, risk assessment and management, succession planning and exit strategies (e.g. Farm Business Resilience Program)	X	X	X	*Planning*
• Continue to improve and make accessible capability building programs to support growers to develop their own drought resilience business plans using environmental and economic assessment tools.	X	X	X	*Planning*
• Support growers to utilise already available farm-level decision-making tools (e.g. Dr Sat)	X	X	X	*Planing*
• Continue incentives to support farming businesses' risk management, including taxation concessions, the Farm Management Deposit Scheme and concessional loans but review the suitability of these	X		X	*Mechanisms*
• Provide tax incentives to land holders to invest in equipment and major works which promote environmental resilience (e.g. earth works for landscape rehydration, expanded rain water capture)	X			*Mechanisms*

Mid West RDRP actions	Action source			Community priority
	Public consultation	Technical consultation	Transformative review	
Collaboration and building capability (continued)				
• Improve or develop appropriate agricultural weather/multi-peril insurance products	X	X	X	*Mechanisms*
• Supporting landholders to adopt new technologies which reduce carbon footprints and improve efficiencies i.e. drones, autonomous electric vehicles	X	X	X	*Planning*
• Working with relevant state agencies and the local private sector, encourage the use of alternative energy sources on farm including developing income from renewables	X		X	*Planning*
• Working with relevant state agencies and the local private sector, improve on farm and community mobile networks and data infrastructure	X	X	X	*Planning*
• Support growers in improving digital and technical literacy, skills and capability, including through the development of local knowledge hubs			X	
• Facilitate the strategic sharing of key rural and regional infrastructure between sectors (e.g. with mining)	X	X	X	*Planning*
• Develop and promote additional tourism opportunities (e.g. Aboriginal, cultural, heritage, wildlife, wildflowers, fishing, food) to promote rural and regional off-farm income, and economic diversification			X	
• Allow tenure adjustments for primary producers to enable diversification and increased revenue from novel income streams (e.g. tourism)	X			*Mechanisms*

Drought Resilience Funding Plan 2020 to 2024 actions

Knowledge, innovation and extension

- Support the collection, management, public accessibility and application of data and information to improve farm and agri-business decision-making, risk assessment and management.
- Support the development of systems and collaborations that enable better analysis and practical application of data and information, including thresholds, trends and projected changes to agri-climatic zones.
- Support the development and availability of an innovative drought resilience research, development, extension and adoption strategy—including a stocktake and evaluation of drought resilience research and extension—in a process that will involve end users to maximise the relevance and adoption of outcomes.
- Encourage the leveraging of investment, including through public and private partnerships and other potential investors, to address gaps and investment opportunities in research, innovation and extension.
- Identify and review innovative solutions developed overseas for drought resilience, with a view to adapting them to suit Australia's agricultural sector.
- Encourage the generation of ideas, information sharing and the adoption of regionally and industry relevant research, development and extension through collaborations with public and private sector extension organisations and networks.
- Support improved weather information over a range of timeframes and levels regarding drought risk, such as early warning systems, seasonal forecasts, future climate projections and impacts for agriculture.
- Support demand driven research including cross-sectoral, development, extension and adoption to expand technologies available to primary producers and agribusiness to respond to risks such as drought—both within their current industries and activities and to enable switches to new enterprises.

Drought Resilience Funding Plan 2020 to 2024 actions (continued)

Collaboration and building capability

- Increase primary producers' understanding of their farm business drought resilience level
    - Including through sharing information—for example, on climate data, soil health, water use efficiency, maintenance of groundcover, capturing carbon and the efficient use of inputs—and/or
    - By encouraging voluntary farm resilience assessments where appropriate.
- Support improved strategic management capacity of farm business managers through the use of innovative tools, improved drought risk business planning, education and training, and improved knowledge of—and access to—market and private sector services.
- Encourage primary producers to adopt innovative approaches and technology, including on and off-farm diversification options or new farming practices, farming systems and markets (e.g. emerging carbon markets).
- Promote approaches that overcome barriers to developing innovative infrastructure or creating new lines of business.

MONITORING, EVALUATION AND LEARNING

Program objectives along with longer-term outcomes, linking to the Funding Plan and FDF Monitoring Evaluation and Learning Framework, are detailed in the program Monitoring, Evaluation and Learning Plan (MEL Plan). The outcomes will continue to be refined collaboratively with the states and territories through the MEL Plan and associated reporting.

State and territory governments will provide robust performance monitoring and reporting to ensure the program meets the program's outcomes, outputs and strategic priorities as documented in the program MEL Plan.

The program's objective included the development and publication of three Regional Drought Resilience (RDR) Plans for priority agricultural areas that have current and predicted future impacts of a drying climate. The RDR plans developed through three regional partnerships, being a Northern Agricultural, a Southern Wheatbelt and a Great Southern Inland consortium respectively.

Quantitative indicator data collected during the monthly dashboard reporting in for consultation events and activities and stakeholders and the MERP at conclusion of the pilot year includes a client survey to collect qualitative data in terms of satisfaction and effectiveness which is used to report against program outputs and outcomes.

The development of the Drought Vulnerability Assessment (DVA) is a key component in the delivery of the Regional Drought Resilience Planning program for the, Midwest, Southern Wheatbelt and Inland Great Southern regions. The goal of a drought vulnerability assessment is to identify key areas of vulnerability to inform priorities and actions to reduce susceptibility to the impacts of drought. It also provides a suite of valuable information that could be used to monitor and evaluate the impact of drought, and success of interventions.

A key tool produced from the DVA is the development of a multi-criteria mapping methodology that synthesises many datasets into a single decision-support tool highlighting priority areas for investment in resilience building activities. It includes a spatial multi-criterion analysis of economic, environmental, and social data relevant to drought to create a drought risk priority areas map.

It is recommended that the DVA is reviewed on a regular basis to integrate updated or new datasets of relevance. This would not only inform future planning and investment but enable longitudinal monitoring of drought resilience.

Future applications of the Vulnerability Assessment methodology should consider resilience to the broader impacts of climate change, not just drought impact, and the vulnerability and adaptive capacity of the broader regional economy, not just the agricultural and allied sectors. The rationale for this is in part because drought cannot be considered in isolation of climate change, and regional communities, while at the surface are dependent on agriculture, are made up of a complex mix of businesses and services, some highly dependent on agriculture, though many increasingly diversifying their own markets. These businesses and services are likely to be the drivers of population and economic growth, building community, and playing an important role in supporting the retention of people, the region's most important resource.

A Vulnerability Index captured for the three pilot regions, has been specifically designed to track change over time, and could be adapted for any region across WA. The index can be seen as a repeatable exercise providing a snapshot of vulnerability to drought. The analysis utilizes the overarching DVA conceptual framework understanding overall vulnerability as the outcome of interacting exposure, sensitivity and adaptive capacity parameters.

Emerging evidence about short-term, intermediate, and long-term outcomes of drought will be communicated and shared, in addition to outcome reports, on a biannual or annual basis and by media releases or specific project outcomes or successes.

Reporting for the pilot year MERP will focus on the short-term outcomes identified in the table below. These will be relatively straight forward will coincide with data collection monthly, bi-annual, final report and client survey data. Where outcomes lie outside these timeframes such as sharing with other regions this can be considered in future DRPs.

Feedback from the pilot MERP and the assessment of the DRPs by CSIRO through the independent review process will be used to adapt the program in response to learnings for future rounds.

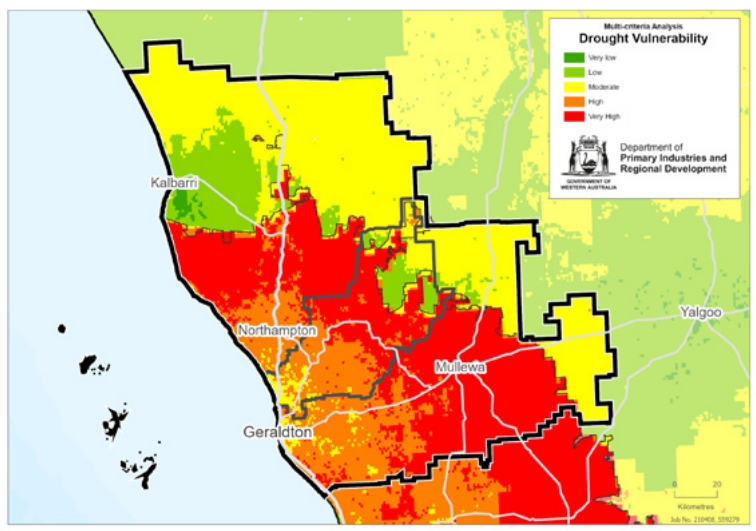


Figure 16. The composite drought vulnerability map highlights drought risk priority areas in the region based on temperature, rainfall and production data, access to infrastructure, population demographics and environmental characteristics. Red and orange areas are considered most vulnerable to drought and should be treated as the highest priority for drought resilience interventions..

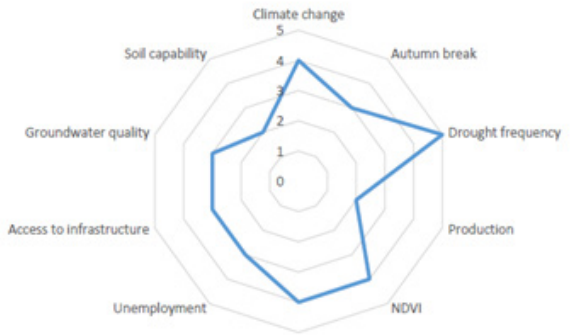


Figure 17. Radar Chart of Vulnerability Index Scores

State tailored program outcomes

WA Regional Drought Resilience Planning program outcomes are consistent with those nationally and will include:

- An evidence-based plan that provides LGAs, Regional Development Commissions, Non-Government Organisations, and industry with a roadmap to guide the transitional and transformational actions needed to strengthen drought resilience and encourage innovative initiatives.
- Increased community and industry understanding of their current level of drought resilience, and the opportunity share learnings with others which could include:
  - The identification of locally applied solutions and existing practices proven to work.
  - Assessment of the environmental and economic outcomes of systems utilised by early adopters of on-farm adaptions and new technologies.
  - Outcome of trials and other research extension activities such as groundwater identification and optimisation, assessment of available and emerging technology, use of systems for desalination and disposal of brine - as examples.
- The gathering of region-specific drought resilience knowledge, data, and agreed actions to inform private sector investment and future government funding initiatives.

State program logic

The State is committed to developing and implementing strong strategic arrangements and partnerships through DPIRDs facilities spread across regional Western Australia, which provide a range of facilities, research, and extension activities to support primary production development, growth and expansion of the sector. This promotes and provides for a shared responsibility for shaping and driving the regional development agenda with the Regional Development Commissions (RDC's).

WA's nine RDCs are statutory authorities established under the *Regional Development Commissions Act 1993* to provide advice to the Minister for Regional Development and to coordinate and promote economic development in the regions. DPIRD works closely with each commission to help them meet their statutory obligations in a manner that contributes to the department's strategic priorities regarding regional opportunities and enabling environments.

DPIRD is also committed to work closely with the SW WA Drought Resilience and Innovation Hub to ensure alignment with the Hubs focus on farmer-centred drought innovation and adoption practices in South-West Western Australia, many of which will overlap with resilience activities identified by communities in the RDRP.

The Plan's proposed themes and interventions have been developed with the community and technical experts, with delivery and impact targeted at the local and regional level, with some interventions having significance beyond the Consortia region. We acknowledge there are many relevant programs already underway or being planned that will support the delivery of this Plan, and to the best of our knowledge, this has been captured in the Investment Framework.

The implementation of the Plan, including identification of priority program areas and the Plan's enduring governance and ongoing resourcing, will be subject to further discussion in coming months with Consortia local governments and potential program delivery partners.

This work will also consider the principles of the feasibility and practicality of proposed actions and the quantitative and qualitative public-good benefits to the region.

Key evaluation questions

The Key Evaluation Questions for the Regional Drought Resilience Plan (the Plan) are:

1. To what extent has the Plan been implemented and has impacted on the regional stakeholders' capacity and resources to better plan, manage and recover from climate challenges?
2. What changes/support are/is needed to ensure that the Plan best provides an effective framework for action and stakeholders can effectively work together towards implementing those actions?

Assumptions underpinning the implementation of the Plan

The FDF MEL plan identified the following assumptions for the plan to be effectively implemented:

Key assumptions affecting outputs to 1–2-year outcomes.

- Regional stakeholders have the capacity and capability to participate in strategic planning.
- Regional stakeholders are willing to cooperate with each other on regional planning.
- Program design is sufficient to give regional stakeholders opportunities to identify and communicate regional drought resilience needs.
- Relevant planning at other scales can be aligned.
- Regional communities are motivated to take ownership of completed plans and actively seek to implement them.
- Communities are willing to share learnings with other regions.
- There are sufficient learnings to inform future program design.

Key assumptions affecting outcomes from 2+ years.

- Supporting consortia of local governments/stakeholders representing a region will result in changes in practice through those regions.
- There are sufficient opportunities for regions to implement elements of plans.
- Plans contain implementable activities to build drought resilience across Australia.
- Regions continue to review, update and implement their plans.

These assumptions will need to be monitored during the implementation phase to provide feedback and highlight areas that require further intervention.

FDF Standard Indicators	Specific Regional Indicators	Evaluation approach
Outcome level: Impacts 4+ years		
1. Agricultural landscapes are functional and sustainable, with healthy natural capital (environmental resilience) 2. Agricultural businesses are self-reliant, productive, and profitable (economic resilience) 3. Agricultural communities are resourceful, adaptable, and thriving (social resilience).	Strong and healthy people living with the land and resilient to drought. • People, culture and communities: Communities' drought resilience has improved. • Economy: Business owners are pursuing opportunities to increase financial security of their business before, during and after drought. • Landscape and natural environment: Land managers are implementing land management practice change to improve the resilience of the landscape and the natural environment to drought. • Infrastructure and built environment: Investing in building, maintaining and improving infrastructure has contributed to increasing the communities' drought resilience.	These longer-term impacts are best captured at a national level by the federal Government through ABARES surveys and other national statistics based on a benchmark and taking into account climate, market and other influences impacting on this outcome. Dr Sat provides a valuable climate tool that also could be used to assess resilience against climate change including drought and other climate risks. The Drought Vulnerability Assessment (DVA) undertaken in the pilot regions to be repeated. The DVA mapped the historical incidence, severity and impacts of drought in the regions, and the physical, economic and social impacts of drought in the future. The socio-economic and environmental data could be tracked and monitored over time to review drought impact, vulnerability and resilience of each region. A Vulnerability Index was developed for the Northern Agricultural region with ten indicators chosen to reflect exposure, sensitivity, and adaptive capacity. It provides a snapshot of vulnerability to drought which can be repeated and tracked over time and aims to assist local decision makers and managers in the rapid evaluation of drought risk in the region. Emerging evidence about short-term, intermediate, and long-term outcomes of drought will be communicated and shared, in addition to outcome reports, on a biannual or annual basis and by media releases or specific project outcomes or successes.

FDF Standard Indicators	Specific Regional Indicators	Evaluation approach
Outcome level: Impacts 4+ years (continued)		
4. Stronger connectedness and greater social capital within communities, contributing to wellbeing and security. 5. Communities implement transformative activities that improve their resilience to drought. 6. More primary producers preserve natural capital while also improving productivity and profitability.	• A regional drought surveillance program is in place that monitors and analyses key indicators of current and emerging environmental (meteorological and landscape), social and economic conditions, which are markers of drought. • There is widely shared and well-informed regional engagement with managing drought risk for long-term community resilience. • The region comes together to build drought resilience. • Widespread enterprise level drought risk is established across the region. • Measures are implemented to limit impacts of drought and better respond to drought. • Adequate and appropriate drought risk management essential infrastructure in place and stress tested for times of drought.	*Critical to the regional-level monitoring of, and improvement to, the Plan will be an on-going regional oversight provided by the Development Commissions in cooperation with DPIRD and key stakeholders within the region during the Implementation Phase. The Development Commissions have the role of initiating actions in line with the plan, reviewing progress against the plan objectives and making changes to the Plan as needed to maintain its relevance and usefulness. A FDF Steering Committee formed within DPIRD will provide a higher level avenue for strategic overarching monitoring and evaluation of the program.* While some of these indicators will be captured in national surveys and statistics as above, monitoring actions that should be taken at regional level by the Development Commissions in cooperation with DPIRD would include: • Monitoring and reporting of regional level indicators that are captured as part of Local Government surveillance, surveys and annual reporting. • Liaising with the regional Drought and Innovation Hub to ensure that key indicators for the region are captured and provided over time. • Linking actions/projects identified by the RDRP Planning Program into strategic priorities of DPIRD, the Hub and the Wester Australian Agricultural Research Consortium (WAARC). • Tracking actions/projects deliverables during the Implementation Phase. • Recording case studies of changes made and benefits evident as a result of actions taken from the implementation of the Plan.

FDF Standard Indicators	Specific Regional Indicators	Evaluation approach
Outcome level: Success measures and intermediate outcomes 2–4 years		
Actions have been taken based on the plans • The majority of plans have had elements implemented. • Primary producers and businesses supported to improve their sustainability and resilience. **Decisions have been made to implement** • Regional representatives have considered and planned incremental, transitional and transformational opportunities to strengthen resilience. • Identified actions, pathways and opportunities (including innovative and transformative) to improve regional drought resilience, mitigate risks and adapt to change. • Communities use relevant data and information to better understand their resilience to plan for drought.	**The achievement of Key Pillars to underpin the achievement of objectives are:** a) Drought monitoring, early warning systems and plans for responses are being developed and refined. b) Those most vulnerable and at risk of droughts have been identified and steps taken to address their vulnerability. c) Measures have been initiated to limit the impacts of and respond better to drought. **Action steps have been taken in line with the Action Plan tables around the key outcome areas of:** • People, culture and community • Economy • Landscape and natural environment • Infrastructure and built environment	**Monitoring actions that should be taken at a regional level by the Development Commission in cooperation with DPIRD include:** • Recording of steps taken, actions initiated, and resources gained that have been triggered by the Plan framework, strategies and planned actions. • Annual reporting and review of plan implementation, engagement, participation, actions, barriers and opportunities to regional stakeholder organisations and government – and changes to the Plan made as needed to best meet regional needs. Survey data will be used as a comparison point from the commencement of the RDRP pilot, and the implementation of projects identified in the RDRP can be measured through their delivery and dollar spend. Should external evaluation be undertaken, as well as taking the national data, above information and annual review into account (against planned actions), a range of regional stakeholders should be interviewed / surveyed to gauge their understanding, engagement and actions they have taken as a result of Plan guidance and initiatives.

FDF Standard Indicators	Specific Regional Indicators	Evaluation approach
Outcome level: Success measures and intermediate outcomes 2–4 years (continued)		
Capacity has been developed • Regional leaders are in a stronger position to implement strategic actions, adapt to change and take advantage of opportunities to build economic resilience as they arise. • Partnerships, networks and engagement are built between stakeholders managing natural resources. • Increased community understanding of the region's current and future drought resilience, considering the region's unique economic, environmental and social characteristics. • Natural resource management capability is improved across region. **Regional stakeholders are involved** • Plans have buy-in from key stakeholders in the region. • The number of, and participation in, local networks and programs to enhance drought resilience increases. • Communities share knowledge, collaborate and partner with government more often to build drought resilience. • Greater sharing of learnings related to drought resilience between communities.		Types of questions should include: • Their level of awareness and understanding of the Plan – and how aware they think others are. • How invested they are in engaging with other stakeholders around the Plan implementation. • How confident they are that they have the skills and resources to make changes highlighted. • What decisions and/actions they have taken – or aware of – that have been initiated as a result of the Plan. • How the Plan has impacted on extra resourcing or support to the region to improve drought resilience. • How they think the Plan has added value and made a difference in increasing drought resilience in the region. • What is working and what needs to change with respect to the Plan and its effecte on-going implementation. • Organisations nominated for actions in the Plan including for the communication engagement activities, should also be interviewed to review what was undertaken, how it was done, what response was gained and, if not, why not. • Case studies should be further captured/developed to understand/demonstrate the program logic / the theory of change and inform recommendations for changes / support needed to maximise the Plan effectiveness. A critical part of an external review would be find an on-going Development Commission who were invested in using the Plan as a framework towards improved resilience, outputs and actions arising and how well this was working towards the Plan's objective. Such external reviewing should be taken annually for the first three years (pilot regions) to provide lessons for plan development and implementation in other regions, then every three years.

REGIONAL DROUGHT RESILIENCE PLAN