Australian National University
Institute for Water Futures

Submission

Inquiry into the effectiveness of Part 3 of the Future Drought Fund Act 2019

Productivity Commission
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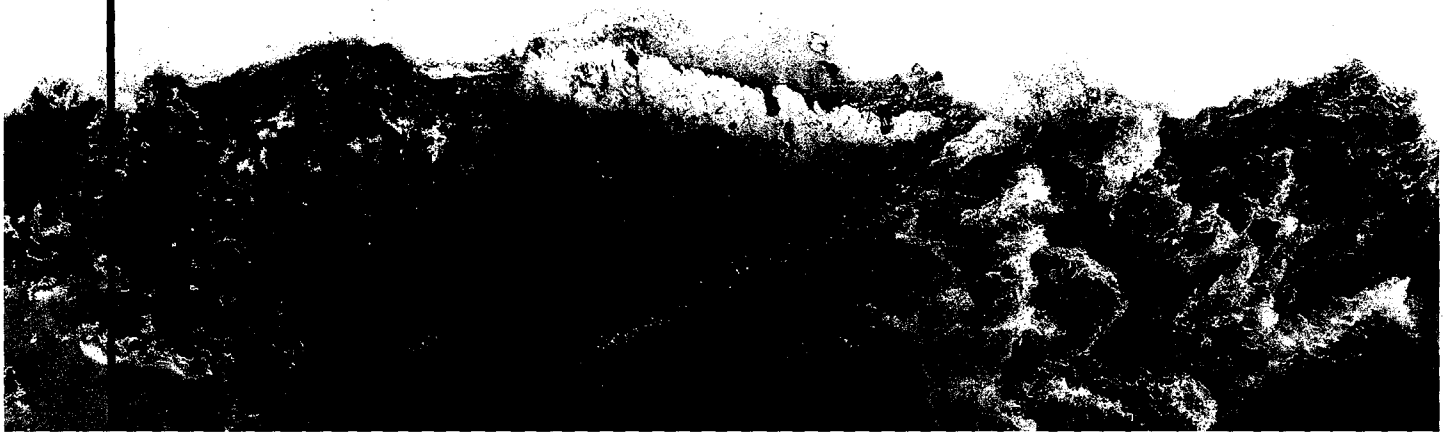

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WE ACKNOWLEDGE AND CELEBRATE THE FIRST AUSTRALIANS ON WHOSE TRADITIONAL LANDS WE WORK, AND PAY OUR RESPECT TO THE ELDERS PAST AND PRESENT.

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1. Introduction

Thank you for the opportunity to provide a submission to the Productivity Commission Inquiry into the *Future Drought Fund.* In this submission, we present high-level observations and recommendations regarding the current Vision, Aims, Objectives and Strategic Priorities of the *Future Drought Fund* (FDF). We will then address the role of universities in the FDF programming to date, and propose that the next iteration of the FDF could usefully consider a Climate Adaptation Innovation System approach. This would recognise the whole innovation system, set relevant high-level goals or targets where needed, and foster engagement, partnerships, collaboration and shared learning for growing future-oriented skills and capabilities across the system. Finally, the submission will propose several areas of potential investment to advance the goals of building drought resilience and enhancing climate change adaptation capability. Recommendations are presented throughout.

The authors of this submission are experts working in the fields of agricultural innovation, water management, climate change adaptation and governance of complex social-ecological systems. We have direct and indirect experience with the FDF through membership of the Southern NSW Drought Resilience Innovation and Adoption Hub, design of FDF programs, as applicants and recipients under FDF funding programs, and in conversation with colleagues of other Hubs elsewhere in Australia. We recognise that the FDF is one part of a complex suite of institutional arrangements addressing the challenging issues around the impacts of climate variability, weather extremes, climate change and adaptation, and social, environmental and economic resilience.

2. Critical assessment of Vision, Aims, Objectives and Strategic Priorities

It is our view that the current FDF Vision, Aims, Objectives and Strategic priorities are too ill-defined to effectively deliver on the specific requirements of drought preparedness and climate adaptation. The vision statement does acknowledge the need for "increased resilience to the impacts of drought and climate change".

While it is undoubtedly the case that greater general resilience (social, environmental, economic per stated Strategic Priorities) would enable businesses, producers and communities to cope better with the impacts of drought or other climate change-related disturbances, drought resilience requires a more specific focus on ***long-term environmental change***. Even though 'resilience' is widely recognised in academic and policy circles to represent maintaining function in the context of changing environments, more generally it carries the implications of bouncing back from episodic drought.

The Fund's Aim and some objectives are too narrowly focused on agriculture and agricultural communities, and should be broadened to be inclusive of all rural, regional and remote communities (as expressed in the Vision); not just those involved in agriculture. **We strongly argue Objective #1: "grow the self-reliance and performance (productivity and profitability) of the agricultural sector" and the associated emphasis on profitability in the Vision statement is NOT an appropriate objective for the FDF**. There are diverse programs addressing productivity and profitability. However, many strategies to improve productivity and profitability are necessarily short-term in nature, and can undermine or be counter-productive for strategies to prepare for or adapt to long-term environmental change. Flexibility is essential for effective adaptation capacity. Conventional approaches to productivity enhancement can lock producers into specific pathways. For example, investments in water infrastructure such as on-farm dams may improve productivity and profitability in the short-term, but represent a greater sunk cost and less flexibility when climate change has advanced to a point where the most effective solutions may be migrating production to different climatic zones. For example, since early 2010s, farmers in the Wheatbelt region, WA, have been altering their agricultural decision-making and practices regarding choice of crops and livestock management, given decreasing and shifting geographical distribution of rainfall.

With regard to Objective #3: "strengthen the wellbeing and social capital of rural, regional and remote communities" this remains too generic to enable the Vision to be achieved. Recasting this objective to reflect the Vision of "increased resilience to the impacts of drought and climate change" would require adding further text, such as "strengthen the wellbeing and ~~social capital~~ adaptability of rural, regional and remote communities **in the context of long-term environmental change**".

> ***Recommendation:*** *The Department of Agriculture, Forestry and Fisheries (DAFF) works in collaboration with Department of Climate Change, Energy, the Environment and Water (DCCEW) as well as the academic community to clarify the meaning and key characteristics of key terms such as 'drought resilience' and*

'climate adaptation', with particular emphasis on how drought or climate resilience is different from, or additional to, more general community development, economic planning or social wellbeing. We recommend the emphasis should be placed on ***strategic planning for long-term environmental change*** *rather than 'resilience' (Funding Rule #14).*

3. Preparing for future drought – the role of universities

Innovation towards effective drought resilience takes place within a complex social, agricultural and ecological innovation system. The innovation system concept underpins this submission, as it is integral to achieving the changes in understanding, options and actions that will support greater drought preparedness, resilience and climate adaptation capability over the long-term. While technological innovation systems, agricultural innovation systems and social innovation are well established in academic literature and analytical applications, we propose that the Future Drought Fund should be based on a ***climate adaptation innovation system***. A climate adaptation innovation system incorporates elements of both technological and agricultural innovation systems and adds the public good dimensions of social and ecological resilience as both motivations and desired outcomes (Funding Rule 2).

Universities play several important roles in this system, throughout any innovation cycle. Researchers continue to build ever-improving understanding of the meteorological and hydrological conditions that underpin the emergence and persistence of drought. From developing new technologies and data sources to generating more accurate predictive models, the science community also drives new possibilities in application and options for drought preparedness, typically in collaboration with partners and end-users. Biophysical and social-economic researchers also have a significant role to play in monitoring the effects of any interventions towards enhancing climate adaptation capacity and drought resilience: what worked? What didn't? Why? This offers critical analysis and shared learning opportunities about which interventions work (or not) in time and place, given context and scale.

Recommendation: *The Future Drought Fund construct its programming with reference to a clear understanding of a climate adaptation innovation system, where the strategic development and strengthening of this system supports the ongoing evolution of solutions to emerging and anticipated climate challenges.*

In the current iteration of the Future Drought Fund, many opportunities have focused on extension and adoption of existing tools, technologies or activities, rather than innovation towards new solutions. Additionally, diverse programs have spread resources thinly, with little scope for genuinely pioneering approaches. As such, it has invested disproportionately in incremental change, and not fully supported the full innovation potential towards more transformative approaches (Funding Rule 6). Similarly, while there is value in adopting a "user-based lens and, where possible, a community-led, co-design, and/or end-user approach" (Funding Rule 8) this also reinforces the incremental change mindset, as users and communities commonly seek to preserve existing livelihoods and social structures rather than consider or implement more radical solutions. In this context, the meaning of 'drought resilience' can easily blend into more general community development, social resilience and economic planning, as improvements in these areas will no doubt enhance a community or region's ability to cope with the stresses imposed by drought and other climate change conditions (eg. bushfires, floods). It also places much of the responsibility and burden of change on communities, rather than the broader institutions that shape and constrain what communities can and cannot do.

It is widely argued that incremental change is not sufficient to prepare for the environmental changes ahead (Shi and Moser, 2021). Mission-oriented approaches are also gaining currency, as goal-driven, multi-actor collaborations towards transformative societal goals; however, in the context of climate adaptation, the specific goals or targets may not always be clear. We believe that **a climate adaptation innovation system would combine mission-oriented processes focused on identified, shared targets and goals, alongside a general capacity to connect and partner across the whole innovation system.** Importantly, with flexibility to adapt and mitigate practices and policies in response to *new priorities* (eg. place-based, community-identified), *critical incidents* (eg. natural disasters); or the *evidence base.* This presents an opportunity for communication and transparency, collective reflexivity, critical analysis, shared learning and collaborative problem-solving to inform action, implementation and evaluation.

> ***Recommendation:*** *The Future Drought Fund recognises the vital roles the university sector plays in innovation and transformation, in driving new technologies; leading data collection and interpretation; monitoring the outcomes of on-site experiments or trials; and supporting future-oriented, long-term capacities, and integrates those roles into their programming.*

Recommendation: *Future investments emphasise partnerships that bring universities, government agencies, communities and producers together in a whole innovation system approach rather than targeting only extension and adoption activities.*

From a university perspective, it has often been unclear where the FDF adds value to the current innovation system, especially where existing organisations emphasise particular industry or sector-specific priorities. Complementarities between the FDF and existing organisations such as the industry-led Research and Development Corporations (RDCs) and a range of related Cooperative Research Centres (CRCs) are unclear (Funding rule #4), leading to both overlaps and gaps as well as risking a sense of competition rather than complementarity.

Recommendation: *The Future Drought Fund clarifies its relationship with other bodies in the current innovation system, including Research and Development Corporations and Cooperative Research Centres, and* ***invests in partnerships*** *where there are overlaps in innovation priorities and needs, in accordance with Funding Principle #4.*

4. Priorities for investment – thematic areas

a. Support transformative innovation

In recent decades, the idea of innovation has been constrained to agriculture and often focused on water market reforms and water use efficiency measures, many of which have been subsidised by Federal Government programs. Conventionally, this has meant 'doing more with less', innovating for greater water efficiency or higher-value agriculture production. However, the extent and scale of environmental change will require more diverse, agile and flexible solutions to more variable water dynamics in time and place, context and scale, given climate zones and geographical landscapes across Australia.

The FDF has the resources and opportunity to invest in bold new areas beyond the farm gate. For example, Managed Aquifer Recharge, the intentional recharge of water to aquifers for subsequent use or environmental benefit is a large-scale approach using local hydrology to capture excess water in natural underground aquifers (see Managed aquifer recharge (csiro.au)). This concept has tremendous potential in Australia's extremely variable climate, but needs substantial investment to become feasible and viable as a management option.

From an institutional perspective, innovation is often lacking (Patterson and Huitema, 2019) and there are many emerging opportunities to enhance the future-orientation of programs and planning. For example, Blue Forest Asset Management in the USA has developed an innovative approach to financing land restoration through 'Forest Resilience Bonds' which is generating new options for public and private stakeholders to 'front-end' activities towards improved water supply and quality, as well as manage fire risks. The Queensland Government is supplementing its environmental modelling activities with a pioneering foresighting process to ensure their scientific work is robust for multiple possible futures. Developing these transformative approaches demands a wider view of emerging innovation and support for public good outcomes (Aim, Funding Rule #2) the FDF is well-placed to provide.

> ***Recommendation**: The Future Drought Fund provides support for a small number of innovations that have the potential to make a transformative difference at a large scale for better management of the increasing variability of rainfall and expected greater demand for water.*

b. Crops and production for greater drought tolerance

Maintaining the current production frontier is increasingly difficult as environmental conditions become more challenging. Water-limited yield potential (WLYP) of wheat in Australia declined by 27% over the period from 1990 to 2015 mostly associated with a decline in rainfall and increased temperatures (Hochman et al. 2017) resulting in potentially lower yields being realised from the same levels of input. In addition, changes to pests, weeds and diseases (e.g., new pathotypes, resistance to control measures, exotic incursions) require increasing levels of control at higher cost (increased inputs) to generate the same yields. Both scenarios cause a decline in the current production frontier if not addressed through ongoing investment and innovation.

The potential future Environmental and Social Governance (ESG) requirements of international customers and importing countries will require close scrutiny to

ensure Australia delivers outputs that address emerging threats, realise opportunities and continue to deliver high quality, functional produce to international and domestic markets. This has the potential to tie in strongly with commitments to explore new and speculative approaches to prepare for the climate challenge, including dealing with elevated temperatures and threats posed by abiotic stresses such as drought, heat and frost. Greater drought preparedness and climate adaptation will require new technologies and production methods to give producers more options - more "tools in the toolkit" - to apply in anticipation of environmental change.

> ***Recommendation:*** *The Future Drought Fund supports investment in innovation for greater drought preparedness and climate adaptation through supporting new technologies and production methods to increase the 'toolbox' of options producers can draw on.*

c. Natural assets for landscape-based resilience

There is a growing body of evidence that farm businesses managing their farm's natural assets effectively, are also more resilient to drought. Examples include protecting remnant vegetation, planting trees, re-establishing native pastures and restoring riparian areas. These investments build the natural capital of farms and provide a wide range of ecosystem services, such as water filtration, carbon sequestration and storage, and habitat for native species. Restoring and protecting some of the key natural assets on farms enables the restoration of some of these ecosystem services into the landscape.

For example, the award-winning Sustainable Farms (SF) program is an interdisciplinary research and extension initiative of The Australian National University (ANU) based in the Fenner School of Environment and Society (FSES). Sustainable Farms has a program of collaborative, interdisciplinary research to quantify and understand the diverse benefits of improved natural capital asset management for farm finances, drought resilience and landscape health. This work has demonstrated the significant value to biodiversity of managing 'natural capital assets' on-farms, such as dams, riparian areas, remnant vegetation and native pastures.

A natural capital asset is "a store of value representing a benefit or series of benefits accruing to the economic owner by holding or using the entity over a period of time" (London Group Natural Capital Forum, 2014). Growing evidence suggests building natural capital assets also supports drought resilience, farm productivity and farmer wellbeing. A national framework for managing natural

capital assets would complement and strengthen efforts to achieve drought preparedness and greater resilience in agricultural and natural systems. It would:

- work collaboratively with regional natural resource management (NRM) agencies, Landcare groups, industry and Indigenous groups
- address four classes of natural capital: land, water, carbon and biodiversity by developing indicators to assess components of these assets, with timely monitoring and evaluation.
- track Australia's progress towards targets for building drought resilience. Rigorous data is required to assess this progress, as well as to help focus policies and resources to meet the challenges; informing action, implementation and prospective evaluation
- ensure the natural assets on farms are sustained and enhanced to support biodiversity, carbon storage, farm businesses and the wellbeing of farmers, their families and farming communities.

Recommendation: *The FDF works with the Australian Government to build a national framework for restoring natural capital assets on agricultural land as a core component of preparedness for long-term environmental change.*

d. Vegetation targets for drought preparedness

Strategic management of natural assets on farms for drought preparedness must include vegetation / revegetation. There is a clear imperative to set specific, measurable targets for this type of management. It is generally accepted that the Vegetation Extent Threshold – a threshold that will support production, biodiversity, river health and landscape function – is 10-30% native vegetation cover across landscapes. But without targets, there is a significant risk that outcomes will not be achieved and, indeed, that degradation of the natural resource base will continue, further reducing our future drought resilience.

For example, in the sheep-wheatbelt of eastern Australia (Victoria-NSW), where the Sustainable Farms project is located, over 90% of the box gum grassy woodland ecological community has been cleared from since European settlement. This has led not only to the loss of plant and animal species, but also negative impacts for agricultural production and resilience - including rising water tables, salinity and erosion (Lindenmayer et al 2018). The value of planting to support production on farms in this area was recognised in the 1980s. Since then, NRM agencies and Landcare groups have been actively engaged in working with farmers to plant shelterbelts and woodlots. There is now a large body of evidence

of the benefits of these plantings for biodiversity, farm productivity and drought resilience (Macbeth, et al. 2022).

However, despite this commitment to planting at a farm and local level, we continue to fall short of reaching even the minimum 10% native vegetative cover. To ensure we can obtain this minimum vegetative cover, targets must be established, leveraging benefits at farm, landscape and national scale.

> ***Recommendation:*** *The Future Drought Fund works with other relevant agencies to develop a national framework for restoring natural capital that supports rural communities to meet environmental targets at national, landscape and farm scale.*

e. Food systems for resilience

Understanding drought and climate adaptation through the lens of a food system can be useful for assessing proposed FDF programs against a range of possible impacts across food-related sectors and activities. The FAO (2018:2) asserts a holistic approach to the food system is necessary, given the complexity of 'inter-linked activities', diverse environmental, economic and social impacts, and the need for 'solutions to achieve transformational systemic change'. The value of systems thinking is to overcome a propensity for silo effects (Tett 2015), such as fragmentation, communication failures, risks within a system, lost opportunities for innovation, and enabling market rivals' exploitation of weaknesses.

A food system consists of multiple moving specialist parts, often disconnected from each other rather than aligned for mutual benefits as a whole. An ABARES inquiry to strengthen biosecurity surveillance in Australia illustrates the value of systems thinking for complex, multi-dimensional challenges (Kruger et al 2022). This approach highlights potential or actual complementarity between different initiatives and can reduce risk-shifting where an improvement in one aspect of food production increases risk in another.

The Consultative Group on International Agricultural Research (CGIAR) has supported the Climate Change Adaptation and Food Security (CCAFS) program over many years. This is a good example of a food systems approach in action, connecting climate change, biodiversity loss, environmental degradation, and the so-called triple burden of malnutrition. The program brings together researchers, development practitioners and civil society groups to tackle these interrelated challenges in holistic and learning-oriented ways.

Recommendation: *The Future Drought Fund considers taking a food systems approach to programming, to build complementarity and avoid shifting risks.*

f. Water policy reforms

Being smarter about how we manage water is an essential dimension of strategic planning for long-term environmental change. In a recent review of over 20 years of climate risk assessments for the Murray-Darling Basin, Alexandra (2022a) noted:

> "Long-term declines in catchment yields are apparent in the MDB ... The Murray River system experienced unprecedented reductions in inflows during the Millennium Drought and between 2000 and 2018, inflows to the Murray were 40% lower than the 20th Century average. ... Warming and drying trends in the MDB's high-yielding catchments are significant because only about twelve per cent of the Basin's area generates two-thirds of the streamflow. Declines in winter and annual average rainfall in these areas over the past 40 years are reducing the volume and reliability of water resources [and] more than 60% of Australia's hydrologic reference stations showing declining trends."

The framework for Australia's water reforms was established in the Council of Australian Governments (COAG) agreement (1994) and reinforced by the National Water Initiative (NWI) (2004). These were formulated when climate risks were not as well understood. It is now timely for Australian governments at national, state/territory and local levels, to consider new water and drought policy architectures - ones that embrace the realities of climate change and the need for more adaptive approaches. The need to critically evaluate adaptation policies is pressing because the impacts of climate change are intensifying. For example, residential, community and commercial buildings and infrastructure on floodplains or eroding coastal margins.

The existing water planning and allocation frameworks needs reform to enable a system to better handle increased variability and more extreme droughts and the FDF can play a key role. This complex policy area is under-researched. There is a pressing need for more research into the kinds of policy reforms needed for water resources management under climate change. Achieving more adaptive policies depends on rigorously assessing climate risk management options and informed by an evidence base. Alexandra (2022b) argues:

> "Given the far-reaching consequences of climate change, rigorous investigations are needed into reforms to the established approaches to water

resources planning and to existing water entitlements and allocation regimes. At minimum, this means reassessing the total resource pool and all subsidiary targets and investigating allocation frameworks that equitably share risks between extractive users and the environment. Achieving more adaptive policies depends on rigorously assessing climate risk management options.

***Recommendation**: The Future Drought Fund supports research and policy development in more climate adaptive systems of water resource planning and allocation.*

g. Governance and institutions for adaptation

Currently the FDF expends $100m/year on a diverse set of activities focused largely on on-farm and on-ground delivery (eg. Drought Resilience Hubs, climate forecasts, community leaders, Landcare, natural resource management). These have meagre funds spread thinly across the range of recipients. With a strong focus of the FDF to date on extension and adoption activities through co-design and collaborative engagement with communities (Funding rule #8), as Alexandra (2022a:10) noted: "Stakeholder participation alone cannot overcome governance deficiencies, so policy and legal reform options are also recommended." For example, the South Australian Government's Royal Commission into the management of the Murray-Darling Basin revealed systemic failings in legal requirements to use the best available science (Walker 2019). The substantial legal and procedural failures in reforms costing over $13 billion highlight how political lobbying, influence peddling, and secrecy about policy decisions erodes democratic accountabilities and community trust (Walker 2019; Grafton et al. 2020). Concerns about interference in scientific independence during these highly politicised reforms have led to calls for reforms re-establishing the integrity of Australia's science-policy institutions.

The FDF has not yet been subject to the same level of scrutiny, and we strongly endorse this current Inquiry process. Many opportunities for innovation in governance and institutions are emerging and could be supported and enhanced through the FDF. Resilience-based planning models offer opportunities for explicitly dealing with risk, complexity and uncertainty (Grafton et al. 2019), as can deliberative approaches improving the quality, representativeness and legitimacy of policy decisions (Dryzek and Pickering 2016). Anticipatory approaches to governance are also emerging as vital to address complex, long-term public-good challenges such as climate change (Muiderman, 2020). Enabling and supporting

long-term partnerships between research and policy agencies, as recommended by the Moran Review of the Australian Public Service (APS) (2010) can improve strategic policy development, build more trusted science-practice-policy relationships (Ison et al. 2018), as well as growing much-needed capabilities of staff within the public service.

Additionally, evidence-based practice and policy can provide direction for prospective collaborative action. Overall, there are pressing imperatives for reforms, which legally define procedural and administrative safeguards for ensuring that the best available science is applied and accounted for transparently in policymaking (Walker 2019; O'Donnell and Nelson 2020).

***Recommendation**: The accountability mechanisms for the Future Drought Fund are overhauled and strengthened to ensure effective delivery of value towards innovation and adaptation in the context of strategic, long-term environmental change, and catalyse others in the climate adaptation innovation and governance system to do likewise.*

5. Conclusion

There are many opportunities for governance, policy and institutional innovations to drive outcomes aligned with the proposed, modified FDF objectives. However it is also clear that realising those opportunities will require major changes throughout the institutional architecture that currently supports the Fund. In expectation that the Productivity Commission will propose substantial reforms to address the need for greater focus on **strategic planning and governance for long-term environmental change**; and positioning the FDF as central to a **climate adaptation innovation system**, we conclude by highlighting our research into the governance reform process itself. Alexandra (2020) has identified four lessons relevant to governance reform for climate adaption:

- reforms will inevitably be highly politicised, involving debates occurring at the intersection of climate science, water resources policies and commercial investment. Therefore, rigorous procedures for the transparent use of the best available science need to be legally prescribed.
- independent oversight functions enabling accountability are critical to the meta-governance challenges of adapting to a changing climate. Community, legal and parliamentary oversight needs well-structured processes for ensuring accountability, transparency, and assurance that science informs policy decisions.
- because climate-adaptive policy development requires sustained political will (in addition to quality science and technical proficiency) the benefits of adopting proactive adaptation policies need to be actively promoted, to build broad-based consensus for reforms.
- institutional changes are needed for adoption of anticipatory policies, due to the increasing dynamism of environmental change and to function effectively in the context of uncertainty about climate futures.

Bold, substantial changes will be needed to enable a more proactive, future-oriented program that can genuinely contribute to achieving the FDF's vision, enhancing national capability to prepare for, and adapt to, ongoing climate change. We hope this submission aids the Commissioners in their deliberations.

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References

Alexandra, J. 2022a. Climate risk assessment in the MDB – a review. *Australasian Journal of Water Resources*, 1–13. https://doi.org/10.1080/13241583.2022.2157107

Alexandra J. 2022b. Climate adaptation options for the 2026 MDB Plan: opportunities for managing climate risk, *Australasian Journal of Water Resources*, DOI: 10.1080/13241583.2022.2133643.

Alexandra, J. 2020. The science and politics of climate risk assessment in Australia's Murray Darling Basin, Environmental Science & Policy, 112: 17-27 https://doi.org/10.1016/j.envsci. 2020.05.022

COAG 2004. Intergovernmental Agreement on a National Water Initiative. The Council of Australian Governments' Water Reform Framework. Canberra: Environment Australia.

Dryzek, J.S. and Pickering, J. 2016. Deliberation as a catalyst for reflexive environmental governance. Ecological Economics, 131, pp.353–360

Food and Agriculture Organization of the United Nations (FAO) 2018. Sustainable food systems: Concept and framework. Rome, Italy.

Grafton, RQ, Doyen L Béné C et al. 2019. Realising resilience for decision-making. Nat Sustain 2, 907–913 https://doi.org/10.1038/s41893-019-0376-1

Hochman Z, Gobbett DL, Horan H. 2017. Climate trends account for stalled wheat yields in Australia since 1990. Glob Chang Biol. May;23(5):2071-2081

Ison R, Alexandra J, Wallis P. 2018. Governing in the Anthropocene: are there cyber-systemic antidotes to the malaise of modern governance? Sustainability Science 13, 1209–1223

Kania J and Kramer M. 2011. Collective Impact. Stanford Social Innovation Review. Winter. 36-41.

Kruger H, Ticehurst J and van der Meer Simo A. 2022. Making general surveillance programs work: Findings from nine case studies. Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES). Research Report 22.10. April.

Lindenmayer, D. B., Michael, D. R., Crane, M., Florance, D., and Burns, E. 2018. Restoring Farm Woodlands for Wildlife. Melbourne: CSIRO Publishing.

London Group Natural Capital Forum. 2014.Towards a definition of Natural Capital. London.

Macbeth, S. M., Young, M. L., Lindenmayer, D. B., Smith, D. G. (2022). Natural Asset Farming: Creating Productive and Biodiverse Farms. Australia: CSIRO Publishing.

Moran Review, 2010. Ahead of the Game: Blueprint for the Reform of Australian Government Administration. Canberra.

Muiderman, K, Gupta, A, Vervoort, J, Biermann, F. Four approaches to anticipatory climate governance: Different conceptions of the future and implications for the present. WIREs Clim Change. 2020; 11:e673. https://doi.org/10.1002/wcc.673

O'Donnell E. L., and Nelson, R. 2020. Shield science for robust decisions. Nat Sustain 3, pages 675–676 https://doi.org/10.1038/s41893-020-0541-6

Patterson J & Huitema D. 2019. Institutional innovation in urban governance: The case of climate change adaptation, Journal of Environmental Planning and Management, 62:3, 374-398

Shi, L. and Moser, S. 2021. Transformative climate adaptation in the United States: Trends and prospects. Science 29 Apr. 372(6549).

Tett G. 2015. The silo effect: Why putting everything in its place isn't such a bright idea. London: Little Brown.

Walker B. 2019. Report of the South Australian MDB Royal Commission South Australian Government. Adelaide.