



Transforming Australian Food Systems – Discussion Paper

Shaping a more equitable, healthy and
sustainable future for Australian food

2022



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Acknowledgement

CSIRO acknowledges the Traditional Owners of the land, sea and waters, of the area that we live and work on across Australia. We acknowledge their continuing connection to their culture, and we pay our respects to their Elders past and present.

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About this Discussion Paper

Invitation to comment

CSIRO invites industry, peak bodies, governments, professional, consumer and civil groups, and individuals to provide comment on the content in this Discussion Paper.

The Discussion Paper will inform the development of an ‘Australian Food Systems Roadmap’. The Roadmap is intended to help guide the sustainable transformation that is necessary across Australia’s food systems.

This Discussion Paper summarises CSIRO’s initial consultation around the opportunities, challenges and enabling actions relating to enabling the transformation of Australian food systems. These findings are not final, and the suggested recommendations proposed for discussion should not be considered final recommendations.

Confidentiality

The content of any submissions will remain confidential and will only be viewed by CSIRO employees in the project team under CSIRO’s Code of Conduct and research ethics procedure. The privacy of data collected using the consultation submission portal will be treated in accordance with their privacy policy. At the conclusion of the consultation period this data will be downloaded and then deleted from the platform. The project team may use contact details provided in a submission to seek clarity on a submission. Information provided in submissions will not be directly attributed to an individual or an organisation in the final Roadmap, however aggregate views may be attributed based on stakeholder characteristics.



1 Introduction

1.1 Imperative for change

Developments in global and national food systems over the past decades have borne numerous positive results, such as more expansive and more convenient product choices to satisfy consumer demands, improved general human welfare, the development of new industries and employment opportunities. However, these rapid changes, alongside converging pressures on the food system have resulted in widespread implications for the state of food security, global nutrition, sustainability of ecosystems, social justice and inclusion, and Aboriginal and Torres Strait Islander sovereignty. Due to this, food systems face an unprecedented set of challenges, but also opportunities.

While Australia is deemed to have strong food systems, there are mounting pressures and entrenched inequities that urgently need to be addressed. Some of these key issues within the global and Australian context are highlighted below.

Climate and the environment: Food systems and changing climates are intrinsically linked and currently contribute adversely to one another. Changing climates impact the ability of producers to grow and produce food, with more frequent and intense extreme weather events. Simultaneously, food systems are exacerbating environmental damage through greenhouse gas emissions, intensive production systems, long and complex supply chains, land-use change, deforestation and loss of natural ecosystems, biodiversity loss, environmental degradation, freshwater use and pollution.¹ It is estimated that food systems emit up to one-third of global greenhouse gas emissions.² Into the future, food systems have the potential to be a major lever for helping to mitigate the impacts of a changing climate.

Human health: Challenges within the food system are a major driver of poor health, with growing inequity in food access and nutrition related public health issues across the globe, including the triple burden of malnutrition (hunger, micronutrient deficiencies and overweight/obesity).³ Current food systems are leading to malnourishment and nutritionally poor dietary patterns, posing an increasingly urgent threat to public health. In Australia in 2018, dietary risks were responsible for 5.4% of the burden of disease, with all dietary risks combined contributing to 50% of coronary heart disease total burden, and up to 26% of other disease burden, including stroke, bowel cancer and type 2 diabetes.⁴ For Indigenous Australians, dietary risk increases to 6.2% of burden of disease, contributing 67% of coronary heart disease.⁵

Population growth: A growing number of mouths to feed across the globe and in Australia puts pressure on food systems. Today, over 820 million people have insufficient access to food.⁶ The global population is expected to reach 10 billion by 2050,⁷ with food demand expected to increase 50–60% between 2019 and 2050.⁸ Meeting this demand in a sustainable manner presents significant risk of further inequities and challenges, combined with complexity of rising incomes driving increased demand for traditional proteins, dairy products, high value horticulture and other premium products, particularly those that support health and wellness.

- 1 Willett W, Rockström J, Loken B, Springmann M, Lang T, Vermeulen S, Garnett T, Tilman D, DeClerck F, Wood A, Jonell M, Clark M, Gordon L, Fanzo J, Hawkes C, Zurayk R, Rivera J, De Vries W, Sibanda L, Afshin A, Chaudhary A, Herrero M, Agustina R, Branca F, Lartey A, Fan S, Crona B, Fox E, Bignet V, Troell M, Lindahl T, Singh S, Cornell S, Reddy K, Narain S, Nishtar S, Murray C (2019) Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet Commissions*, 393. [https://doi.org/10.1016/S0140-6736\(18\)31788-4](https://doi.org/10.1016/S0140-6736(18)31788-4).
- 2 IPCC (2019) Summary for Policymakers. In: *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* (Eds. Shukla P, Skea J, Calvo Buendia E, Masson-Delmotte V, Pörtner H, Roberts D, Zhai P, Slade R, Connors S, van Diemen R, Ferrat M, Haughey E, Luz S, Neogi S, Pathak M, Petzold J, Portugal Pereira J, Vyas P, Huntley E, Kissick K, Belkacemi M, Malley J). HLPE (2020) Food Security and nutrition: building a global narrative towards 2030. High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.
- 3 WEF and FAO (2022) *Transforming Food Systems: Pathways for Country-led Innovation*. White Paper January 2022. World Economic Forum and Food and Agriculture Organisation of the United Nations.
- 4 Fan S (2021) Economics in food systems transformation. *Nature Food*, 2. <https://doi.org/10.1038/s43016-021-00266-0>
- 5 Australian Institute of Health and Welfare (2021) *Australian Burden of Disease Study 2018: Interactive data on risk factor burden*, AIHW, Australian Government.
- 6 Australian Institute of Health and Welfare (2022) *Australian Burden of Disease Study 2018: Interactive data on risk factor burden among Aboriginal and Torres Strait Islander people*, AIHW, Australian Government.
- 7 Willett W et al. (2019) Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet Commissions*, 393. [https://doi.org/10.1016/S0140-6736\(18\)31788-4](https://doi.org/10.1016/S0140-6736(18)31788-4).
- 8 Kirova M, Montanari F, Ferreira I, Pesce M, Albuquerque J, Montfort C, Neirynek R, Moroni J, Traon D, Perrin M, Echarri J, Arcos Pujades A, Lopez Montesinos E, Pelayo E, (2019). Megatrends in the agri-food sector: global overview and possible policy response from an EU perspective. *Research for the AGRI Committee*. European Parliament, Policy Department for Structural and Cohesion Policies, Brussels.
- 9 Falcon W, Naylor R, Shankar N (2022) Rethinking Global Food Demand for 2050. *Population and Development Review*. <https://doi.org/10.1111/padr.12508>

Supply chains: The COVID-19 pandemic, conflict in Ukraine, cybersecurity breaches, rising geopolitical tensions and recent natural disasters have highlighted fragilities and vulnerabilities of global and national supply chains. Disruptions to these supply chains are felt across all Australian communities, disproportionately impacting communities already at high risk of food insecurity (for example, low socioeconomic and remote communities).

Waste: Current food systems are not as optimised or efficient as they need to be to reduce excessive food loss and waste alongside other types of waste such as plastic waste. This undermines the sustainability and resilience of the food system, presenting an opportunity to grow the value of these system through novel processing and manufacturing technologies. Globally, it is estimated that 17% of total food production may be wasted, and 8–10% of greenhouse gas emissions are associated with food that is not consumed.⁹

Globally, there is increasing momentum towards food system transformation to help address these key issues; however, the window for action is closing rapidly. While support and momentum is building (particularly following the COVID-19 pandemic), the complex interconnected nature of global food systems means that transformation efforts in one jurisdiction may be hampered if not supported by other jurisdictions. Food system transformation is supported by the United Nations Sustainable Development Goals (SDGs), with food systems supporting critical progress across all 17 goals.¹⁰ The 2021 United Nations Food Systems Summit helped build more global momentum for this transformation, bringing together key players across the world from science, business, policy, healthcare, academia, primary production, youth organisations, Indigenous people, consumer groups and environmental activists. The summit highlighted that food system innovations will be vital to achieving multiple SDGs by 2030.¹¹ More recently, COP27 included a Food Systems Pavilion for the first time, putting food centre stage during crucial climate negotiations.¹²

In Australia, the interconnected nature of food systems means that decisions made far from the farm, manufacturer or consumer will often have significant influence and implications on these systems. As the nation looks towards the future of food seeking greater sustainability, security, resilience, productivity, improved health and equity, the imperative to work together to resolve tensions and enact change becomes more urgent. Industry, research, government and community food system stakeholders have an opportunity to come together and work towards a more sustainable future for Australian food – which is an environmental, social and economic imperative.¹³ Delaying action risks the food system’s collective social impact,¹⁴ and will see Australia falling behind other global nations, with implications on the environment, health and livelihoods.

What are food systems: food systems encompass the entire range of people, places, processes and businesses involved in the production, processing, packaging, distribution, preparation and consumption of food, and the waste produced throughout these processes. Food systems underpin environmental sustainability, economic prosperity, human health and social wellbeing, and are inextricably linked to other vital systems, including the health, trade, cultural, environment and energy systems.¹⁵

A sustainable food system is environmentally, economically, culturally and socially resilient.

9 Forbes H, Quested T, O’Connor C (2021) Food Waste Index Report 2021. United Nations Environment Programme, Nairobi.

10 United Nations (2021) Food Systems Summit x SDGs. <<https://www.un.org/en/food-systems-summit/sdgs>>

11 United Nations (2021) About the Summit. <<https://www.un.org/en/food-systems-summit/about>>

12 Food Systems Pavilion (2022) Accelerating #ActionOnFood for people and planet <<https://foodsystemspavilion.com/>>

13 WEF and FAO (2022) Transforming Food Systems: Pathways for Country-led Innovation. White Paper January 2022.

14 WBCSD (2019) CEO Guide to Food System Transformation. World Business Council for Sustainable Development.

15 Adapted from Nguyen H (2018) Sustainable food systems Concept and framework. Food and Agriculture Organization of the United Nations; Wood A, Gordon L, Rööös E, Karlsson J, Häyhä T, Bignet V, Rydenstam T, Hård af Segerstad L, Bruckner M (2019) Nordic food systems for improved health and sustainability Baseline assessment to inform transformation. Stockholm Resilience Centre, Stockholm University.

1.2 This Paper

This Discussion Paper presents a guide towards enabling the transformation that is necessary across Australia's food systems, to reach a more healthy, equitable and sustainable future. The Discussion Paper will inform the development of an Australian Food Systems Roadmap that outlines how Australia might achieve this food future.

This Discussion Paper takes a systems lens by looking at the entire food system and its many interacting systems, and paints a vision for the future of food in Australia. Five areas are prioritised to help enable the transformation of Australia's food systems:

1 Enabling equitable access to healthy diets

2 Reducing waste and improving circularity

3 Reducing greenhouse gas emissions

4 Improving environmental and economic resilience

5 Improving value and productivity

The vision, five focus areas and associated opportunities, suggested recommendations and R&D priorities presented in this Paper are informed by national consultation with industry, government, the civil sector, and research stakeholders from across the food system and its interacting systems, including CSIRO's research expertise. Suggested recommendations span infrastructure, governance, workforce and the system-wide requirements to enable the sustainable transformation of Australia's food systems. However, this Paper is not designed to be completely exhaustive – it does not cover every possible opportunity available to food system participants.

This paper draws upon several national frameworks, industry visions and strategies, and global goals (such as the SDGs). CSIRO's Protein Roadmap¹⁶ identified the need for this piece of work, which presents a whole-of-food system view.

This Discussion Paper summarises CSIRO's initial consultation for this project. These findings are not final, and the suggested recommendations proposed for discussion should not be considered final recommendations.

Food system transformation: Food systems are complex and adaptive systems, that involve multiple stakeholders, levels and functions, and display non-linear dynamics. Transformation of these systems is complex and involves uncertainties, systemic trade-offs, cross-system interactions and conflicting perspectives and tensions.¹⁷

Driving transformation of food systems requires technological innovations across the entire food value chain, while ensuring transparency and building societal trust for these emerging technologies.¹⁸ Redirecting the food system transformation towards a more sustainable and productive trajectory will require investment across multiple specific domains and technologies, but also more systemic interventions that deliver multiple co-benefits.

¹⁶ CSIRO Futures (2022) Protein - A Roadmap for unlocking technology-led growth opportunities for Australia. CSIRO, Canberra.

¹⁷ European Commission, Directorate-General for Research and Innovation, (2021). Research & innovation for accelerating food system transformation: operationalising FOOD 2030 through living labs, Publications Office. <https://data.europa.eu/doi/10.2777/122836>

¹⁸ Herrero M, Thornton P, Mason-D'Croz D, Palmer J, Benton T, Bodirsky B, Bogard J, Hall A, Lee B, Nyborg K, Pradhan P, Bonnett G, Bryan B, Campbell B, Christensen S, Clark M, Cook M, de Boer I, Downs C, Dizyee K, Folberth C, Godde C, Gerber J, Grundy M, Havlik P, Jarvis A, King R, Loboguerrero A, Lopes M, McIntyre C, Naylor R, Navarro J, Obersteiner M, Parodi A, Peoples M, Pikaar I, Popp A, Rockström J, Robertson M, Smith P, Stehfest E, Swain S, Valin H, van Mijk M, van Zanten H, Vermeulen S, Vervoort J, West P (2020) Innovation can accelerate the transition towards a sustainable food system. *Nature Food* 1, 266–272. <https://doi.org/10.1038/s43016-020-0074-1>.



2 A vision for Australia's food systems

An agile, productive and resilient food system that is carbon neutral, less wasteful, and that enables equitable access to, and consumption of, healthy foods.

This vision for the future of Australia's food systems was informed by broad industry consultation. Reaching this vision will require transformative change within Australia's food system.

From (2023)	To (2050)
Variable food access across Australian communities and increasingly unbalanced diets	All Australians have access to affordable and healthy food, regardless of location, socio-economic status and cultural background. Equitable access and consumption contributes to improved population nutrition. Consumers are empowered to make purchasing decisions that support their health and have equitable access to the services, equipment and facilities that support healthy food consumption. Food is consumed sustainably while preserving and celebrating food culture.
High levels of food waste and loss and other wastes across the supply chain	An Australian circular food system with zero avoidable food waste. Unavoidable food and packaging waste along the value chain is redistributed or transformed into value-added products as part of an increasingly thriving circular bioeconomy.
Emissions intensive processes and products	A net negative emission Australian food system that values nature-based solutions and sequesters carbon. Food producers and supply chain participants are empowered and understand how to minimise emissions while remaining productive, and consumers are informed and can easily make purchasing decisions that support lower emission diets.
Vulnerable and regularly disrupted food supply chains	An environmentally sustainable, economically viable and socially responsible food system that is resilient and has the capacity to withstand system-wide disturbances. This includes the ability to absorb threats without severe setbacks, reduce environmental damage to ensure long-term functionality, adapt to changing conditions and ultimately undergo transformation to reduce risks and vulnerabilities.
Ageing and inefficient food production infrastructure and practices , ¹⁹ and commodity driven exports	Domestically grown and manufactured food products that are underpinned by technology and innovation-driven production changes, unique differentiation and provenance, enabling Australian farmers and processors to capture greater value in domestic and offshore markets with diverse, value-added offerings. High value food products currently seen as novel or newly established are widely exported by Australian businesses.

¹⁹ RDS Partners (2021) Exploring the growth potential of Australia's food manufacturing sector: A new narrative for Australia's agrifood system. January 2021. Prepared for Page Research Centre. <<https://www.page.org.au/wp-content/uploads/2021/01/AIFST-RDS-2021-Exploring-the-growth-potential-of-Australias-food-manufacturing-sector-V2.pdf>>

2.1 Food system transformation values

Reaching a more sustainable future for Australian food will require collaboration, connection and mutual understanding across the wide and varied range of stakeholders within and adjacent to Australia's food systems. The task is large and there are many diverse views and objectives that must be navigated. Depending on where certain food stakeholders sit within the food system, their view on participating, contributing and understanding the imperative for the transformation will differ.

While pursuing food system transformation in Australia, it is important that any mechanisms employed consider the **environment, human health, livelihoods and equity**.

Australian food systems must:

- equitably feed the entire Australian population now and in the future, even during weather extremes and other supply disruptions
- embed Indigenous knowledge systems and practices in a manner that centres self-determination
- contribute to advancing global food and nutritional security
- not compromise environments
- avoid wastage
- support livelihoods.

2.2 Taking a systems lens

This Discussion Paper takes a systems lens to the transformation required to shape a more sustainable future for Australian food. It considers the entire food value chain and the many other systems that interact with Australian food. This systems level lens is required to drive a coherent, collaborative, cross-sector approach to transformation.

This Discussion Paper also considers the need for holistic and deliberate integration of Indigenous knowledge systems and agricultural approaches throughout the food system, in a manner that centres self-determination.

Given this systems lens, there are many inherent overlaps in opportunities identified and suggested recommendations across the focus areas presented throughout this Discussion Paper. Transformation and opportunities in some focus areas will have substantial co-benefits for others. As such, it is important to consider these linkages, and associated data flows, policies and stakeholders, when developing solutions in these areas and implementing the proposed recommendations.

3 Enabling the transformation

To drive progress towards achieving Australia’s vision, recommendations across five critical focus areas have been identified:



Enabling equitable access to healthy diets



Reducing waste and improving circularity



Reducing greenhouse gas emissions



Improving environmental and economic resilience



Improving value and productivity

Each focus area identifies a 2030 target to help Australia reach the proposed 2050 vision.

Opportunities across the value chain have been identified for each focus area through consultation with government, industry, research and civil society.

Suggested recommendations are provided to highlight how Australian government, industry, research, civil society and community groups can work together to capitalise on these opportunities and reach the vision. Some of these recommendations will be systemic in nature, while others are more stand-alone.

R&D priorities are suggested to help shape the science, technology and innovation needed from Australia’s research community to reach the vision.

Opportunities, recommendations and priorities in some focus areas will have substantial co-benefits for others, and these co-benefits and linkages should be considered throughout.



3.1 Enabling equitable access to healthy diets

2030 Target

Australia redesigns food systems to be more adaptable and diverse, with strengthened localised systems to meet community needs and establish equitable access to safe, nutritious, acceptable, sufficient and sustainably produced food all year round and for all people.

2050 Vision

All Australians have access to and are consuming affordable, healthy and safe food, regardless of location, socio-economic status and cultural background. This equitable access contributes to improved population nutrition and reduced burden of disease. Consumers are empowered to make purchasing decisions that support their health, and have equitable access to the services, equipment and facilities that support healthy food consumption. Food is consumed sustainably while preserving and celebrating food culture.

Although Australia is recognised as a food secure nation that produces enough food to feed approximately 60–75 million people, the current food system is failing in its ability to adequately provide all Australians with equitable access to safe, nutritious and affordable foods produced in line with Australia’s biophysical constraints and without exceeding planetary boundaries. Many vulnerable and marginalised populations continue to face food insecurity (e.g. people living in remote and regional communities, refugees and asylum seekers, Aboriginal and Torres Strait Islander Australians, and elderly people), while the proliferation of ultra-processed and unhealthy foods contribute to increasing cases of diet-related non-communicable diseases placing growing burdens on Australia’s healthcare system and the environment. Action is needed to transform the food system to ensure it can provide all Australians with accessible, affordable, safe, appropriate and sustainable foods that meet their diverse nutritional and cultural needs.

Opportunities across the value chain

- Transforming nutritional and dietary guidelines to include attributes of equity, sustainability for human health and environments, and ensure they are culturally diverse
- Securing equitable access to healthy food for Aboriginal and Torres Strait Islander and remote communities
- Developing localised food systems that prioritise local procurement and shorter supply chains, to strengthen community access to fresh healthy food including in under-served areas
- Shaping retail and commercial food environments to support healthy and sustainable food choices, including integrating a greater portion of healthy and nutritious ingredients
- Improving institutional procurement practices to incorporate a greater emphasis on healthy, sustainable and nutrient-dense foods (including disincentivising unhealthy foods), and prioritising local procurement to support shorter supply chains and financial sustainability of local food enterprises
- Supporting innovative business models, such as social enterprises, that deliver food solutions that enable equitable and community-determined food access
- Reducing food insecurity and malnutrition amongst populations by building enhanced and resilient supply chain against shocks and stressors
- Adopting best practice methods that support behaviour change towards healthier, more nutritious and more affordable foods through access to robust information that informs choice
- Embedding First Nations research and knowledge systems and practice into food systems transformation across the value chain
- Embedding principles of equity, sustainability for human health and environments, and respect for cultural diversity across the relevant policy and practice domains, as well as across innovation systems to transform innovation practice outcomes

Suggested recommendations for enabling equitable access to healthy diets

- Invest in and strengthen local food system resilience by supporting community aspirations for local food production, and the development of food networks, collaborations and optimised local logistics
 - Develop public education campaigns about Australia's food system, its impacts on health, and providing information on updated nutrition guidelines
 - Broaden collaboration between community, government and industry to better understand local needs and challenges for place-based solutions
 - Review legislative and policy opportunities and barriers to enable healthy diet choices and making fresh produce more affordable and available
 - Recommence the national diet and nutrition survey to collect regular, comprehensive, accurate data on the purchasing and consumption patterns of Australians (e.g. every 4 years)
 - Develop investment and incubation programs to grow self-determined First Nations food ventures
 - Address structural issues that impact healthy food consumption (e.g. healthy homes, food purchasing environments, nutrition education, addressing food deserts and swamps) by building a learning network that shares knowledge on how these goals can be achieved in different contexts and that reveals the broader changes needed in policy and practice
- Scale up precision and targeted nutrition, for example, through institutional procurement (such as hospitals, correctional facilities, schools and aged care facilities)
 - Research into best practice tools and approaches for fostering behaviour change and best practice industry guidelines
 - Modelling and risk assessment tools to identify and address accessibility gaps, including geographic assessments of communities with inequitable food access (e.g., 'food deserts' and 'food swamps')
 - Integrated data platforms to enable greater engagement and participation for all stakeholders across the value chain
 - Research in systems-based approaches, with an emphasis on balancing ecological, health, social, cultural and economic goals²⁰
 - Real-time diagnostic tools and traceability technologies to detect food safety hazards and aid in food recall events

R&D priorities

Presented below are the research and development priorities that were outlined during stakeholder consultation to inform this report. Alongside these priorities for the research sector, significant demonstration, extension and commercialisation activities are required.

- Improve population data and nutritional surveillance (more regular and better quality) to inform policy responses towards food related inequities and chronic illnesses, including improved collection of data metrics for Aboriginal and Torres Strait Islander Australians
- Identify platforms to support the integration of diverse Indigenous knowledge systems and practices across the food system

Have your say

Tell us what you think about the vision, opportunities, suggested recommendations and R&D priorities outlined.

Questions

1. How can industry, government and communities work together to increase the adoption of more sustainable and nutritious diets?
2. What legislative and policy opportunities can ensure equitable access to healthy diets?
3. What strategies would be most effective to improve affordable community access to healthy food in regional and remote Australia?
4. Are there any other R&D priorities that should be addressed to ensure Australian food systems become more equitable? Which priorities are the most urgent?

²⁰ Global Alliance for the Future of Food (2021) How to Transform Food Systems: 7 Calls to Action.



3.2 Reducing waste and improving circularity

2030 Target

Australia, realising its 2030 National Food Waste Strategy Goals and 2025 National Packaging Targets, halves its food waste at the retail and consumer levels, and reduces food, packaging and other losses along production and supply chains.

2050 Vision

An Australian circular food system with zero avoidable food waste. Unavoidable food and packaging waste along the value chain is redistributed or transformed into value-added products as part of an increasingly thriving circular bioeconomy.

Food loss and waste (FLW) is a highly complex issue; between 4 and 13% of Australians can be classified as food insecure.²¹ Despite this, approximately 28 million tonnes of agricultural and fisheries waste are generated each year accounting for over 65% of Australia’s organic waste production, and 7.6 million tonnes of food is being wasted (approximately half of this occurs prior to reaching consumers), generating significant social, environmental and economic costs.²² Australia’s FLW (kilograms of food wasted per person per year) is substantially higher than the average FLW for all other high income countries.²³

Beyond FLW, plastics and packaging play a unique role in extending food life and reducing food loss, but are environmental pollutants. In light of these tensions, there is a need to transform Australia’s food system to be more circular, efficient and sustainable to improve the social and environmental wellbeing of both Australian consumers and natural landscapes.

Opportunities across the value chain

- Reducing packaging and distribution related waste through increased use of sustainable and recyclable materials, and increasing information embedded into food products that capture waste metrics
- Reducing emissions through reducing FLW
- Empowering consumer behaviour change through nationwide education campaigns
- Embedding circularity principles into the food system, for example, food rescue and/or transformation of waste for other use across value chain
- Industry development around Australian value-added products from by-products
- Optimise value chains from producer to consumer to better align production, harvest, and post-harvest quality assurance with consumer demand

21 Nolan R, Rajadurai E (2020) Mapping Food Insecurity: an Index for Central and North Queensland. Mckell Institute Queensland.

22 FIAL (2021) The National Food Waste Strategy Feasibility Study – Final Report; Department of Agriculture, Water and the Environment (2020). National Waste Report. Retrieved from: <https://www.dcceew.gov.au/environment/protection/waste/national-waste-reports/2020> Date accessed: 29 November 2022

23 United Nations Environment Programme (2021). Food Waste Index Report 2021. Nairobi.

Suggested recommendations for reducing waste and improving circularity

- Invest in and implement strong technology solutions along the food supply chain to reduce waste (both food waste and excess plastics and packaging)
- Review regulation and legislation that may prevent redistribution of surplus food and redesign public policy to enable this, and review potential mechanisms to incentivise circularity and reduction of waste
- Develop industry pathways for cross-sector food waste transition and food waste-to-animal feed
- Build scale of the food rescue sector
- Scale waste collection and recycling capabilities in Australia
- Develop nationwide public education campaigns about Australia's food system, its impacts, the processes of getting food from farm to table, and reducing food waste and plastic use
- Revisit industry practices around 'best before' dates on packaging
- Invest in circular economy incubators
- Address structural issues that impact FLW and are barriers for more circular interventions, by building a learning network that shares knowledge on how these goals can be achieved in different contexts and that reveals the broader changes needed in policy and practice

R&D priorities

Presented below are the research and development priorities that were outlined during stakeholder consultation to inform this report. Alongside these priorities for the research sector, significant demonstration, extension and commercialisation activities are required.

- Methods to estimate the full cost of products (including waste disposal) and embedding product life cycle assessment data into costing
- Life Cycle Assessment of plastic use across the value chain

- Mapping pathways for both avoidable and unavoidable waste across all food sectors
- Research into best practice tools and approaches for fostering contextualised consumer behaviour change, and strengthening the enabling environment for intervention uptake (e.g., building trust, social licence)
- Sustainable packaging to extend the shelf life of perishable and non-perishable food
- Digital tools for FLW reduction, recovery and redistribution (i.e., food donation management)
- Innovations for enabling transition to circularity and more optimised value chains (i.e., end-of-life product management, storage improvements, supply chain cold chain infrastructure, post-harvest quality assurance and data sharing)

Have your say

Tell us what you think about the vision, opportunities, suggested recommendations and R&D priorities outlined.

Questions

5. How can industry, government and communities work together to reduce waste and improve circularity?
6. What are the best ways to empower producer and consumer behaviour change to help reduce waste and improve circularity?
7. Which organisations are best placed to lead and/or support implementation of the suggested recommendations?
8. Are there any other R&D priorities that should be addressed to ensure Australian food systems reduce waste and improve circularity? Which priorities are the most urgent?



3.3 Reducing greenhouse gas emissions

2030 Target

Many industries within the Australian food system are carbon neutral, including the red meat sector and other primary producing industries, and various food and beverage lines within the manufacturing and retail industry.

2050 Vision

Net negative emission Australian food systems that value nature based solutions and sequester carbon. Food producers and supply chain participants are empowered and understand how to minimise emissions while remaining productive, and consumers are informed, and can easily make purchasing decisions that support lower emission diets.

The imperative to reduce greenhouse gas (GHG) emissions from across the food system is strong – food systems are both a victim of and a contributor to environmental degradation and climate change,²⁴ and are responsible for around one third of global emissions.²⁵ In Australia, food systems are estimated to contribute between 30–40% of domestic GHG emissions.²⁶ While significant efforts are underway to reduce Australia’s food system emissions, more must be done across the system to reach the 2050 vision. Food systems, underpinned by extensive potential to sequester carbon in soil, trees and other ecological systems, are one of the greatest levers to halt and reverse climate change.

Action is needed to reduce GHG emissions associated with food production, processing, packaging, distribution, consumption and waste through improved processes and technologies, and greater nature based solutions like sequestration.

Opportunities across the value chain

- Embedding evidence based sustainability principles across agriculture and the broader food supply chain to meet growing consumer expectations
- Leveraging Australia’s natural resources (solar, wind, etc.) to integrate renewable energy sources throughout the supply chain
- Scaling up to industry-wide adoption of emerging agricultural technologies for emissions reduction, carbon sequestration and biodiversity enhancement
- Supporting First Nations communities to use sustainable, low-emissions Indigenous agricultural approaches, in a self-determined manner
- Growing and developing industries for diversified lower emission protein alternatives
- Reducing emissions by reducing food loss and other waste (linked with Section 3.2)
- Enabling an efficient carbon market that delivers value to farmers, streamlines access and encourages good land management
- Expanding the range of climate-neutral foods available to enable more sustainable diets

24 Fan S (2021) Economics in food systems transformation. *Nature Food*, 2. <https://doi.org/10.1038/s43016-021-00266-0>

25 Mbow C, Rosenzweig C, Barioni L, Benton T, Herrero M, Krishnapillai M, Liwenga E, Pradhan P, Rivera-Ferre M, Sapkota T, Tubiello F, Xu Y (2019) Food Security. In: *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* (Eds. Shukla P, Skea J, Calvo Buendia E, Masson-Delmotte V, Pörtner H, Roberts D, Zhai P, Slade R, Connors S, van Diemen R, Ferrat M, Haughey E, Luz S, Neogi S, Pathak M, Petzold J, Portugal Pereira J, Vyas P, Huntley E, Kissick K, Belkacemi M, Malley J). In press; Crippa M, Solazzo E, Guizzardi D, Mnforti-Ferrario F, Tubiello F, Leip A (2021) Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food* 2, 198–209. <https://doi.org/10.1038/s43016-021-00225-9>

26 Victorian Food Security and Food Systems Working Group (2022) *Towards a Healthy, Regenerative, and Equitable Food System in Victoria: A Consensus Statement*; Crippa M *et al* (2021) Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food*, 2. 198–209. <https://doi.org/10.1038/s43016-021-00225-9>.

Suggested recommendations for reducing emissions

- Continued development of agricultural and food manufacturing sustainability metrics with a strong evidence base, and best practice guidelines/standards for industry
- Enable upgrades or alternatives to inefficient and emissions intensive technologies across the food system (e.g., ageing food manufacturing infrastructure)
- Make Life Cycle Assessments more accessible across industry and work towards making this information accessible to consumers
- Encourage renewable energy integration into food production and manufacturing operations
- Educate and empower consumers with information on sustainable food producers
- Support agriculture and food SMEs to navigate emissions reduction pathways, including how to adapt, avoid, mitigate, offset and verify
- Review and update policy frameworks and tools to align food industry goals and ensure various policies are not working against each other
- Provide clarity around market mechanisms and business financing models that support sustainable land management

R&D priorities

Presented below are the research and development priorities that were outlined during stakeholder consultation to inform this report. Alongside these priorities for the research sector, significant demonstration, extension and commercialisation activities are required.

- Research to integrate sustainability-related best practices for agricultural sectors and food manufacturing (including the best practice use of emerging technologies, e.g., data collection and integration, etc.)

- Social science to support transition of food industries and rural communities towards operating in a lower emission world
- Development of existing and novel renewable energy technologies and integration feasibility for agricultural sectors and food manufacturing
- Research and pilot studies to investigate best practice for sustainability labelling on foods
- Develop high priority low and negative emission technologies for agriculture and food production
- Measurement and data collection tools to improve accuracy of GHG calculations
- Define best practice food and packaging waste reduction

Have your say

Tell us what you think about the vision, opportunities, suggested recommendations and R&D priorities outlined.

Questions

9. Which organisations are best placed to lead and/or support implementation of the suggested recommendations?
10. What existing agricultural and food manufacturing sectors are recognising sustainability-related best practices?
11. Are there any other R&D priorities that should be addressed to ensure Australian food systems can reduce emissions? Which priorities are the most urgent?



3.4 Improving environmental and economic resilience

2030 Target

Australia’s food system is more agile, information is more freely shared between participants, and procedures for predicting and responding to threats (i.e., biosecurity, natural disasters, climate change, cybersecurity, etc.) are tested and become increasingly robust. There is greater adoption of sustainable land management practice to improve biodiversity and ecological environments, meanwhile supply chains offer greater diversity, in part supported by improved domestic manufacturing capability.

2050 Vision

An environmentally sustainable, economically viable, and socially responsible food system that is resilient to system-wide disturbances. This includes the ability to absorb threats without severe setbacks, reduce environmental damage to ensure long-term functionality, adapt to changing conditions and ultimately undergo transformation to reduce risks and vulnerabilities.

Australia’s agrifood industry has recently been impacted by several disruptive events that have had significant ramifications for all participants across the food value chain.

As Australia continues to face these complicated chronic stressors (such as population growth and natural resource limitations) and disruptive shocks (such as endemic outbreaks, geopolitical conflicts and natural disasters), the ability of the food system to provide fair and reliable access to food for consumers and livelihoods for participants is greatly impacted.²⁷ Meanwhile, conventional and intensive agricultural practices are contributing to climate change and degrading environments,²⁸ and producers are facing business constraints such as limited workforce and land availability²⁹ – all of which are jeopardising the long-term functioning capacity of the food system. The globalised nature of environmental and economic structures means that Australia’s food system is squarely embedded within the global food system and its many interacting parts; creating impetus to address broader global sustainability pressures as well as protect against the event of local and international destabilising shocks.

Defining food system resilience: In recognising that a food system is not sustainable unless it is resilient, this report considers a resilient food system to be one that is **robust** in its ability to withstand pressures, yet **agile** and **adaptive** in responding to them; towards the goal of having the capacity to continually provide people with access to sufficient and healthy food, even when facing disruption.³⁰

27 Bottani E, Murino T, Schiavo M, Akkerman R (2019) Resilient food supply chain design: Modelling framework and metaheuristic solution approach, *Computers and Industrial Engineering*, 135. <https://doi.org/10.1016/j.cie.2019.05.011>; Davis K, Downs S, Gephart J (2021) Towards food supply chain resilience to environmental shocks, *Nature Food* 2, 54–65. <https://doi.org/10.1038/s43016-020-00196-3>; Victorian Food Security and Food Systems Working Group (2022) Towards a Healthy, Regenerative, and Equitable Food System in Victoria: A Consensus Statement.

28 Mbow C et al. (2019).

29 AgriFutures Australia (2019) *Agriculture— A \$100b sector by 2030?* ACIL Allen Consulting for AgriFutures Australia. National Rural Issues.

30 This definition of food system resilience, as it relates to sustainability, was informed by several stakeholder interviews and existing definitions in literature, including: Seekell D, Carr J, Dell’Angelo J, D’Odorico P, Fadar M, Gephart J, Kummu M, Magliocca N, Porkka M, Puma M, Ratajczak Z, Rulli C, Soweis S, Tavoni A (2017) Resilience in the global food system, *Environmental Research Letters* 12. <https://doi.org/10.1088/1748-9326/aa5730>; Fanzo J, Haddad L, Schneider K, Bene C, Covic N, Gaurin A, Henforth A, Herrero M, Sumaila U, Aburto N, Amuyunzu-Nyamongo M, S Barquera, J Battersby, T Beal, P Molina, E Brusset, C Cafiero, C Campeau, P Caron, A Cattaneo, P Conforti, C Davis, F DeClerck, I Elouafi, C Fabi, J Gephart, C Golden, S Hendriks, J Huang, A Laar, R Lal, P Lidder, B Loken, Q Marshall, Y Masuda, R McLaren, L Neufeld, S Nordhagen, R Remans, D Resnick, M Silverberg, M Cullen, F Tubiello, J Vivero-Pol, S Wei, J Moncayo (2021) Viewpoint: Rigorous monitoring is necessary to guide food system transformation in the countdown to the 2030 global goals, *Food policy* 104. <https://doi.org/10.1016/j.foodpol.2021.102163>; Biehl E, Buzogany S, Baja K, Neff R (2018) Planning for a resilient urban food system: A case study from Baltimore City, Maryland. *Journal of Agriculture, Food Systems, and Community Development*, 8(Suppl. 2), 39–53; Carey R, Larsen K, Sheridan J, Candy S (2016) Melbourne’s food future: Planning a resilient city foodbowl. Victorian Eco-Innovation Lab, The University of Melbourne.

Opportunities across the value chain

- Advancing climate-smart and sustainable agricultural practices for improved resilience and a healthy environment
- Strengthening and growing Australia's food manufacturing capabilities to be resilient and responsive to global supply chain shocks, including growing the pipeline of skilled workers for the sector
- Building diversified food supply chains to improve system flexibility
- Building transparent and trusted food supply chains to better identify and address supply chain weaknesses and stress points
- Regional food industry development and capacity building
- Industry-level adoption of risk management strategies to bolster business resilience

Suggested recommendations for improving resilience

- Foster collaboration and knowledge sharing across the value chain to identify priority supply chain weaknesses and solutions
- Strengthen business resilience through, for example, alternative revenue streams and improved workforce sustainability
- Build transparent and diversified food supply chains and support the participation of new enterprises, particularly SMEs and Indigenous food ventures
- Explore place-based solutions to support rural and remote communities
- Greater implementation of sustainable land management practices and adoption of climate-smart agricultural technologies to support long-term environmental sustainability
- Invest in infrastructure, skill-building and upskilling to bolster Australian capacity, including production, manufacturing and distribution capabilities
- Develop and deploy traceability technologies across the supply chain to verify food credentials and allow for timely responses to threats

R&D priorities

Presented below are the research and development priorities that were outlined during stakeholder consultation to inform this report. Alongside these priorities for the research sector, significant demonstration, extension and commercialisation activities are required.

- Bioengineered biological treatments and climate-tolerant cultivars for improved agricultural resilience
- Process engineering for greater flexibility within production, manufacturing and transportation operations
- Developing and enhancing digital systems that can collect and aggregate data for multi-use purposes that support resilience outcomes
- Development and deployment of automation, drones and robotics to address labour shortages and reduce volatility in seasonal employment
- Research and piloting of new market mechanisms and business financing models to improve business resilience
- Research and testing of new adoption pathways and mechanisms to increase the uptake of newly developed technologies/solutions

Have your say

Tell us what you think about the vision, opportunities, suggested recommendations and R&D priorities outlined.

Questions

12. Which organisations are best placed to lead and/or support implementation of the suggested recommendations?
13. How can cross-sector data sharing be encouraged across all levels of the system? And what kind of data would producers, manufacturers, retailers, consumers and the logistics industry find most useful for improving resilience?
14. What national manufacturing capabilities would be most practicable in reducing reliance on importing critical inputs (for example: food products, agricultural chemicals, processing equipment)? And what are the potential obstacles and costs to their implementation?
15. What do you think are the most important features of a resilient food system? Do you agree with the definition outlined?
16. Are there any other R&D priorities that should be addressed to ensure Australian food systems are environmentally and economically resilient? Which priorities are the most urgent?



3.5 Improving value and productivity

2030 Target

Australia realises its target to exceed \$100 billion in farm gate output by 2030.³¹ Additional value is generated from highly differentiated and value-added food products as Australia begins to significantly ramp up domestic processing and manufacturing capabilities, leveraging its strong national advantages in particular food areas while still supporting resilience and sustainability.

2050 Vision

Domestically grown and manufactured food products are underpinned by technology and innovation-driven production changes, unique differentiation and provenance, enabling Australian farmers and processors to capture greater value in domestic and offshore markets with diverse, value-added offerings. High value food products currently seen as novel or newly established are widely exported by Australian businesses in 2050.

The nation's agriculture and food production sector is a major driver of economic growth and social prosperity, with nearly three-quarters of agricultural, fisheries and forestry output being exported.³² Ensuring ongoing success in this area requires Australian producers and exporters to respond to changing consumer demands, regulatory complexity and uncertainty, domestic and global supply chain volatility (e.g., from climate, biosecurity, and geopolitical-related factors), as well as a broad suite of environmental, health and welfare considerations.

Greater focus is needed on ensuring Australia's food production sectors can effectively address these multifarious challenges while improving both the productivity and value of their offerings. Additionally, these sectors must navigate the possibility that some of these aims may be in tension.

Opportunities across the value chain

- Australia becoming a regional leader in sustainable and healthy food system transformation and providing assistance to low and middle-income countries through the export of expertise and technology
- Developing Australia's Indigenous First Nation's Food Industry and embedding social and cultural food metrics to increase value in both domestic and export markets
- Diversifying Australia's range of export options and capturing greater value in new export markets – while adapting to emerging trade standards (e.g., on climate and sustainability) in overseas markets
- Fostering healthy and sustainable natural capital to protect current and future productive capacity
- Integrating Australian commodities and processed items into global value chains in order to create more value adding opportunities for the sector.
- Sustainable workforce jobs creation and regional industry development through the strengthening and growing of Australia's food production and manufacturing capabilities

³¹ NFF (2019) 2030 Roadmap: Australian Agriculture's Plan for a \$100 Billion Industry. National Farmers Federation.

³² ABARES (2022) Snapshot of Australian Agriculture 2022. Australian Government Department of Agriculture, Fisheries and Forestry. ABARES Insights, 1. <<https://www.agriculture.gov.au/abares/products/insights/snapshot-of-australian-agriculture-2022#around-72-of-agricultural-output-is-exported>> (accessed 28 November 2022).

Suggested recommendations for improving value and productivity

- Attract and retain a robust labour force and ensure skilled workers have the capabilities to keep pace with new technology advancements
 - Streamline and simplify the export regulatory/compliance environment to reduce red tape and increase participation by businesses, particularly SMEs
 - Identify and establish new overseas export markets
 - Identify and build strong relationships with comparable international markets to collaborate and share insights
 - Improve input efficiency in food production, particularly the use of Australia's natural capital
 - Construct, scale-up and upgrade infrastructure (production, processing and logistics) to meet increased production demands
 - Work with Aboriginal and Torres Strait Islander communities to build and scale-up self-determined Indigenous food ventures and identify systemic barriers and enablers to food system opportunities
- Develop and scale new production platforms (e.g., precision fermentation, biomanufacturing, cell-based agriculture)
 - Improve resource management strategies (e.g., chemicals, water, soils, energy, by-products, land management)
 - Research into best practice approaches and tools to assist farmers and processors to manage any external or internal food credential and traceability regime
 - Research into best practice models and tools to encourage new products that balance economic growth and environmental, health and social considerations

R&D priorities

Presented below are the research and development priorities that were outlined during stakeholder consultation to inform this report. Alongside these priorities for the research sector, significant demonstration, extension and commercialisation activities are required.

- Co-production of robust social and cultural First Nations food metrics
- Improvement and deployment of digital technologies to verify food credentials and enable traceability across domestic and international supply chains
- Digital and automated export compliance procedures
- New product development of functional foods, alternative foods, and value-added products
- Process engineering and technology development for improved production efficiencies, including scalability of production infrastructure

Have your say

Tell us what you think about the vision, opportunities, suggested recommendations and R&D priorities outlined.

Questions

17. Which organisations are best placed to lead and/or support implementation?
18. What should be considered appropriate success measures of value and productivity improvement?
19. Do the opportunities, recommendations and R&D priorities sufficiently address the risks and challenges that food growers and manufacturers might face as they seek to improve value and productivity?
20. Are there any other current and emerging food system opportunities that should be included in this focus area?
21. What additional gaps in technology and research need to be addressed to support growth in the food system, especially in terms of mechanisms for translating research into practice?

4 Indicator shortlist

No single data-driven indicator can perfectly capture each of the five focus areas. As such, the Australian Food Systems Roadmap will collect and analyse several quantitative indicators to illustrate, measure progress, and support the narrative in each focus area. However, it is also important that these statistical metrics do not overwhelm or overcomplicate the roadmap structure.

The table below provides the current shortlist of potential indicators for inclusion in the Roadmap across the five focus areas. The project team has decided on a maximum of ten currently published indicators in each focus area, with an emphasis on the availability, quality, and recency of data for Australia. These indicators are drawn from existing food systems databases (such as the John Hopkins Food Systems Dashboard³³) and Australian-specific sources.

Shortlist of potential indicators

FOCUS AREA	POTENTIAL INDICATORS
Enabling equitable access to healthy diets	<ul style="list-style-type: none"> • Affordability of a healthy diet (at national as well as regional levels, depending on data availability) • Dietary risk levels in the population (linked to diet-related disease outcomes) • Extent of nutritional diversity of food supply • Geographic measures of access and availability to affordable and healthy food (where data is available) • Inadequate fruit and vegetable intake rate • Prevalence of mild, moderate, and severe food insecurity across households • Retail value of ultra-processed food sales per capita <p><i>Where data exists, these indicators will also be explored for First Nations Australians.</i></p>
Reducing waste and improving circularity	<ul style="list-style-type: none"> • Extent of recycled water • Household and retail food waste measures • Food production (e.g. agricultural and food manufacturing) waste measures • Per capita waste linked to food consumption • Post-harvest food production losses (across fruits, nuts and seeds, pulses, vegetables, and cereals) • Recycling rates for organic and non-organic waste
Reducing greenhouse gas emissions	<ul style="list-style-type: none"> • Greenhouse gas emissions from agricultural land activities • Greenhouse gas emissions from pre- and post-production activities in the food system • Greenhouse gas emissions from the entire agri-food system of Australia • Per capita greenhouse gas emissions of food consumption • Renewable energy usage in agriculture and other food-related activities

³³ Global Alliance for Improved Nutrition (GAIN) and Johns Hopkins University (2020) The Food Systems Dashboard, <<https://www.foodsystemsdashboard.org>> (accessed 1 December 2022).

FOCUS AREA	POTENTIAL INDICATORS
Improving environmental and economic resilience	<ul style="list-style-type: none"> • Agricultural land change during the last ten years • Agricultural water withdrawal as a percentage of total renewable water resources • Australia’s Environmental Performance Index score • Average proportion of natural vegetation embedded in agricultural lands • Biosecurity measures, including quantification of negative biosecurity impacts on the food system (where possible) • Integrated plant nutrient management (nitrogen use efficiency and land use efficiency) • Per capita water use linked to food consumption • Risk from climate change, including quantification of damage to food system due to negative climate impacts (where possible) • Supply chain infrastructure levels • Total ecological footprint of consumption and production per person
Improving value and productivity	<ul style="list-style-type: none"> • Agricultural infrastructure levels • Agriculture, forestry, and fishing value added per person • Average size of agricultural holdings • Crop yield indicators • Extent of sustainable land management practices in the agricultural sector • Fertiliser consumption • Food export growth measures • Innovation investment expenditure in agriculture • Share of employment in agriculture • Share of food and beverage manufacturing sector value added

Have your say

Tell us what you think about the list of indicators outlined.

Questions

22. Can this indicator approach be used to track different dimensions of the food systems transformation process and examine whether change is occurring and going in a desirable direction?

23. Is the current shortlist appropriate? Are there any indicators listed that should be removed?

24. Are there any currently existing indicators with Australian data that should be included?

25. Should the indicators be used for cross-country comparison (if the data is available) or focused solely on Australia and domestic changes over time?



5 Have your say

Tell us what you think about the opportunities, suggested recommendations and R&D priorities outlined across five focus areas in this Discussion Paper.

1 Enabling equitable access to healthy diets

2 Reducing waste and improving circularity

3 Reducing greenhouse gas emissions

4 Improving environmental and economic resilience

5 Improving value and productivity

Comments received about this Discussion Paper will be used to inform the development of an 'Australian Food Systems Roadmap'. This Roadmap will be made publicly available during 2023 and aims to support the transformation of Australian food systems towards a more sustainable future.

The Roadmap will provide expanded explanations for each opportunity, recommendation and R&D priority.

These findings in this Discussion Paper are not final, and the suggested recommendations proposed for discussion should not be considered final recommendations.

How to have your say

Read the Discussion Paper

Have your say

via the CSIRO Futures webpage or alternatively, email your submission to futures@csiro.au

Have your say by

7 February 2023

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