

Should the Future of Farming Include Farmers?

Participant Information Booklet



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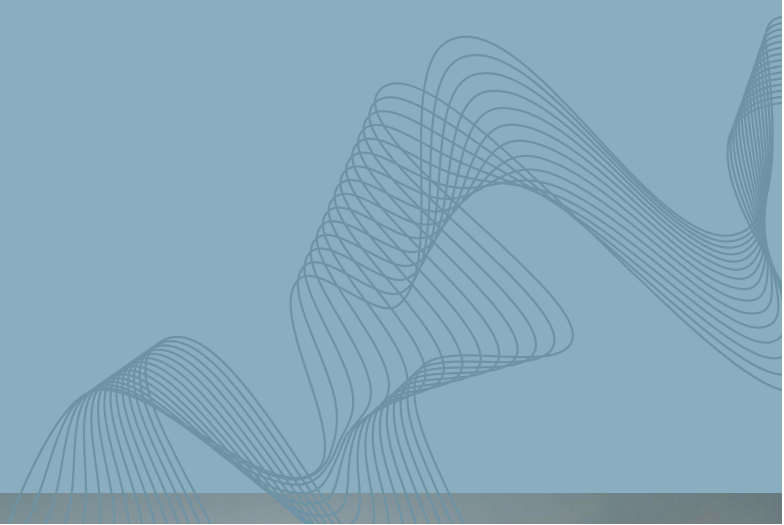
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Glossary

Artificial Intelligence - a set of computer-based technologies that can do things (reason, learn, and act) that previously required human thinking and action.

Automation - the use of computer software, machines or other technology to carry out a task that would otherwise be done by a human.

Cropping - wheat and other grains, oilseeds, pulses, rice, sugar, cotton and seeds.

Crop yield - the measurement of crop harvested per area of land.

Digital agriculture – a catchall term that includes ‘smart’ farming and precision agriculture. This includes AI and robotic technologies such as machine learning (see machine learning), sensors, drones, and predictive data analysis. This can inform decision-making around sowing, harvesting and resource use.

Farmerless farms – a fully automated farm, that is, a farm without a farmer. For example, crops being fully grown and harvested by drones, driverless tractors and combines etc., rather than human operators and direct human decision-making.

Horticulture - cultivating, propagating and producing intensively managed crops such as fruits, vegetables, flowers, foliage, trees, shrubs and plants.

Livestock - domesticated animals raised in an agricultural setting, regarded as an asset.

Machine learning – a branch of AI and computer science focused on the use of data and algorithms to enable AI to imitate the way that humans learn, gradually improving its accuracy. It is based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention.

Monoculture - the cultivation of a single crop species in a given field.

Robots - agriculture robots are programmable machines with sensors and actuators (or motors) that can move and/or move things in the world. They perform operational tasks such as harvesting, applying pesticides and weeding and animal husbandry, while intelligently responding to their environment.

Frequently Asked Questions

Can robots identify which trees or individual fruit to harvest on a given day?

Robots have cameras and scanners which can diagnose unripe or bad fruit and pick at the optimal time according to an algorithm or an AI system.

Would there still be human workers to help the robots e.g., empty fruit-catching bins while robots continue with picking fruit?

In a fully automated farm, robots would pick the fruit into the bins, which would then be conveyed via a remotely controlled or AI-operated tractor to a facility for sorting and packing and loading onto a truck.

In fully automated farms, would there be any farmers actually on the land?

There would not be a farmer who lives near or on the farm. A person or computer would be operating the farm from a distance.

A farmer can notice if chickens are sick. How does AI and robots perform this task?

Robots are being developed that can identify changes in patterns of behaviour and predict or notice ill chickens through cameras and sensors etc.

Would AI and robots in poultry production provide medical care to chickens?

Standard practice in poultry farms for any animal that's showing signs of illness would be to destroy it and monitor the flock.



The Current State of Australian Agriculture

Australia's agriculture sector accounts for substantial land-use, water-use, and global exports. Agriculture depends on climate and weather factors, labour shortages and availability, and market conditions. The sector is important to Australia's economy, and accounts for just under 15% of all exports.

- **Agriculture uses 55% of all land and 70% of water**
- **Agriculture adds 2.7% to Australia's GDP**

Production value of agriculture:

- In 2023-2024, agricultural production had a gross value of \$82 billion. This is expected to rise to \$84 billion in 2024-2025
- Poultry is of high value. In 2022-2023, the poultry sector was locally valued at \$3.6 billion.
- Horticulture accounts for over \$12 billion in gross value. In 2022-2023 fruit production (excluding wine grapes) was valued at \$6.3 billion, and vegetable production valued at \$5.8 billion.

Agricultural exports

Around 72% of the total value of agricultural production was exported between 2017-2020.

How much agricultural produce do we export?

78% of beef and veal
67% of wheat
39% of dairy
33% of fruit and nuts
6% of pig and poultry

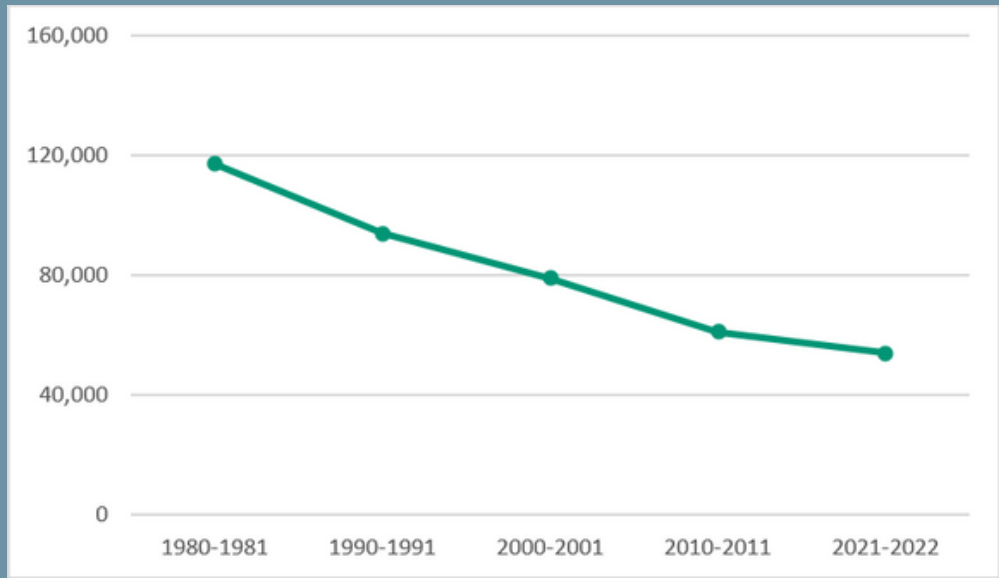
Farm incomes

Even though agricultural production is highly valued, farm incomes are varied. Larger farms are becoming more profitable in the current agricultural sector. This is due to the ability of large farms to cut costs and invest in efficiencies. Boosts in productivity and production value being currently experienced is primarily being driven by these larger farms.

The changing farm sector

The total number of farm businesses are dropping. At the same time, farm sizes are increasing. As of 2022, the majority of farms were classified as broadacre livestock and cropping farms, with dairy farms dropping in number. The graph maps the overall drop in the number of broadacre farms.

Number of farms, 1980-81 to 2021-22



Farm labour

As of 2023, the agriculture sector employed over 250,000 Australian residents. This was an increase of 2.4% from the previous year, but does not count overseas workers. Farm labour is highly variable and depends on seasonal needs. Horticulture relies on highly casualised and contract labour, often from overseas. For example, the horticulture sector employed over 160,000 labourers on the farm in January 2020 alone. This falls during off-season periods, and was affected by the COVID-19 pandemic.

Agriculture, the environment, and biosecurity

Agriculture has an effect on the environment. Since 2005, the sector has contributed around 12-15% of national greenhouse gas emissions. At the same time, climate trends are forecast to effect agriculture. Since 2000, seasonal conditions (such as higher temperatures and low winter rainfall) has seen an overall drop in many farm profits. This is especially true for the south-east and south-west. Risks of drought also threaten low incomes, low production, and price volatility, which was true pre-2000.

Biosecurity threats also threaten significant economic impacts. Biosecurity threats include foot-and-mouth disease, Avian flu, and African Swine Fever. The costs of these outbreaks can include:

- Foot-and-mouth disease: estimated to cost around \$80 billion over 10 years, from 2020.
- African Swine Fever: has become endemic to Australia and is expected to cost up to \$2.5 billion.

Referenced from: ABARES 2024, Snapshot of Australian Agriculture 2024, ABARES Insights, [Issue 1], Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra, March.



The Positives of AI, Robotics, and Farmerless Farming

As the population grows, there is a rising global demand for food. Farmers need to adapt and produce more food on existing farmland, and can do this with AI and robot technologies.

Decision-making

Because AI and robotics collect data, it will improve decisions made by farmers. AI and robotic technologies will help farmers know more about:

- Animal welfare
- Pests and diseases
- Fertiliser and pesticide use
- Water use
- Animal management
- Crop growth
- Harvest times



Source: <https://www.analyticsinsight.net/edge-computing/edge-computing-reshaping-the-agricultural-sector-with-smart-farming>

Sustainability

AI and robots are important for environmental sustainability. Sensors and drones can monitor crops, soil, and livestock, providing real-time data on environmental conditions. This will then inform farmers on the precise use of resources such as water, fertiliser, pesticides, and feed. Farmers can then be both cost-effective and sustainable with their resource-use. Precision farming will allow farms to produce more food more efficiently on existing land.



Food security and production

AI and robots will ensure global food security. AI systems give farmers real-time data to make the best decisions about growing food. This data can predict the best times to sow and harvest crops based on a mix of farming conditions. Robotic sensors and drones can also identify the precise amounts of water, feed, and fertilisers for optimal production. With this data, farmers can maximise production to grow the most amount of food with the least amount of resources. Food production will become more reliable as robots can undertake repetitive farm tasks.

Animal welfare

AI and robots has benefits for animal welfare. Humans can be a source of stress to birds in farms. Replacing humans with robots will limit human-bird contact and can improve animal welfare. By using robots, farms can also save on labour costs. This means that these savings could then be used to enrich farm environments for birds.

Biosecurity

There are also biosecurity benefits to reducing human-bird contact. Highly-transmissible avian flu can lead to pandemic conditions and millions of human deaths. Outbreaks will also lead to the culling of bird populations can have adverse mental and economic impacts for farmers. Robots will reduce the risks of human-bird transmission of avian flu. In addition, robots will be able to monitor and detect diseases, prevent outbreaks, and slaughter infected animals. This removes humans from disease risks and allows for constant monitoring and prevention.



Source: <https://www.poultryworld.net/home/robotics-revolution-happening-now/>

Negative Consequences of AI, Robotics, and Farmerless Farming



Farmerless farms can be harmful to farm livelihoods, the environment, and for workers. Data-intensive AI systems can intensify and create threats to farms, while farming practices can become lost and replaced through robotics

AI and robotics are costly

Farmers will need to spend significant amounts of money for AI and robotics to be adopted on scale. Many farmers will need to invest in new technologies, such as AI-enabled sensors, drones, tractors, and



robots. For these tools to work, farmers will also need to upgrade digital networks. This will be costly for many and risks worsening existing financial burdens. These investments will favour large business and push out smaller farmers who cannot afford to transition.

Economic effects and ownership

As AI and robots are costly, the number of farms may drop. The technologies will be owned by large corporations. Farmers will often have to lease - and not own - machinery and technology. This will widen the existing gap between large and small farms based on who can afford the transition.

Farming decisions can also be made by overseas players. AI and robots can be remotely operated, meaning that people do not have to be on, or near, the farm to make decisions. More advanced AI technologies can use predictive data and algorithms to make informed decisions without any human input.

This will also have an effect on employment levels. Human labour will no longer be required as robots become more efficient in key tasks. This will make many farming jobs redundant and drive down the wages of remaining workers. Labour will also be outsourced for updating, upgrading, maintaining, and servicing specialised equipment.

Farmers will also face new threats with data. AI-enabled drones and tractors will collect and translate real-time data. This will often become the property of the AI or equipment company. Farmers will have to pay to access data to be able to use the data for decision-making.



Environmental effects

AI and robotics can worsen the environmental harms of farming. Farms will need to be standardised for the operation of AI and robotics. This will lead to more monocultural farms. In poultry farms, birds may be confined to spaces that allow for robots to monitor their movement and detect and prevent diseases.



Loss of farming knowledge

All of this has an effect on farming livelihoods and community. For many, farming is an important way of life. AI and robotics will drastically change what this looks like. Many farmers will no longer have to make all the decisions on farming, and will follow the predictive data of AI systems. This will have an effect on generational knowledge of farming. Farmers will also become disconnected from the land, as manual labour is less required of them.

Rural communities will also change. With less employment on farms, rural towns may struggle to maintain key services. Farm workers living in rural towns may also leave in search for new job opportunities.

Public Views About AI and Robots in Agriculture

International research on digital agriculture

In 2023, we conducted a literature review to identify global research papers on public attitudes toward AI and robots in agriculture. We found a small body of research looking at public perspectives on, drivers, and challenges of digital agriculture.

Most of this research has been conducted in European countries including Germany, the Netherlands, Finland and Spain, with one study examining global social media data. This research focuses on the commonly held public attitudes toward the benefits and risks of AI and robots in agriculture across European countries (box 1 and 2).

Research findings suggested that publics generally accepted the partial replacement of human labour by AI and robots. However, most publics were sceptical of complete replacement, and believed there was a need for robust national and international policies in its adoption.

Additionally some publics saw digital technologies as potentially supporting increased transparency of farm processes through data sharing with consumers. This transparency was seen as supporting and improving best practice in animal farming.

Box 1: Benefits of AI and robots

- improved productivity
- Environmental sustainability (for future generations)
- Job creation
- Improved quality of life for farming families
- Improved farm animal health and welfare

Box 2: Negatives of AI and robots

- Increased industrial production
- Job loss
- Data ownership and transparency issues
- Data leaks, cyber-crime
- Expensive technologies and higher food prices
- Animal cruelty or reduced animal welfare

Australian dialogue groups

In late 2023, we held 12 online “dialogue groups” (67 participants). Participants were presented with hypothetical scenarios of AI and robots in fruit picking and poultry production. Groups were asked to discuss the social and ethical effects of AI and robotics in agriculture and consider what might influence their decisions to accept or reject these technologies.

Dialogue group participants held similar views to those presented in international research, with specific insights into the Australian context. They generally agreed that AI and robots could: (1) enhance agricultural productivity and efficiency, (2) overcome existing labour shortages, (3) meet global demands for food production, (4) enhance environmental sustainability, and (5) boost Australia’s economic and trade position. However, groups were largely undecided on how - or whether - AI and robotics should be used in agriculture.

Participants raised various **trade-offs** for consideration:

- being globally competitive versus responsibility as a ‘global citizen’ e.g. jobs for seasonal workers
- sustainability from precision farming using AI versus human employment
- capacity to increase production versus loss of rural community connections
- quality of life of poultry versus practicalities of egg production and biosecurity

Most groups **expressed two firm caveats to their acceptance of AI and robots**:

- there should always be **human oversight** of technologies
- **animal health and welfare** should be at the fore of decision-making

The farmerless farm

There were **mixed views on the concept of farms without farmers**.

While not necessarily against “farmerless farms”, participants raised concerns, including:

- **Equity issues** - pricing out smaller farms and associated businesses
- **Wealth and power** over agricultural land
- **Foreign ownership and national control** of AI-enabled agriculture of the nation’s AI-enabled agriculture
- Vulnerability to **cyber attacks and data breaches**



Who is the farmer?

Participants reflected on what it meant to be a farmer, and the character and future of rural communities. For some, farmers might become ‘**farmer-technicians**’. Others valued a **more traditional vision** of the farmer with fully automated agriculture leading to social and cultural loss. These participants saw the role of farmers to be **stewards of the land**, with generational farming knowledge, that could not be achieved by a technician that controlled farm operations remotely.



In summary... we’re still scratching the surface

Research reveals a range of views on AI and robots in agriculture. In the dialogue groups and international research **it remains unclear the extent to which the public accepts AI and robotics** in different fields of application.



Does Farming Make Us Human?

The history of farming

Agriculture has played an important role in human society. Agriculture has been linked with the development of civilisation and shaping cultures. This has been developed through over 10,000 years of human agriculture, farming, and land cultivation and management practices.

Our place in the world is often represented through different stories that feature animals, plants, food production, and farming communities.

Farming and nature

Agriculture is also a place where humans have historically interacted with the natural world. Through different forms of farming, humans have learned to live in relationship with animals and plants. These relationships also allow humans to have an intimate knowledge of land and place.

Farming and justice

Distribution of food is one of the most fundamental ethical issues of agriculture. Food insecurity is a specific concern where people have limited access to, or the inability to get, safe and nutritious food. This can be due to a number of reasons such as a lack of financial and other resources, location, time, and food prices. Some believe, issues of food distribution can be solved by increasing food production, while others see this as an issue of equity.

What Farming Teaches Us

Farming teaches farmers important virtues.

- Practical wisdom
- Humility
- Temperance
- Sense of justice.

The rest of the community learn these virtues in part from the examples of farmers.



The Future of Agriculture...

How would it affect our sense of what it means to be human if there were no farms and no farmers? Would it have an effect on human society for better or worse?

Currently less than 3% of the Australian workforce work in agriculture. Most people also consume their food through large supermarket chains. So, most Australians are largely alienated from our sources of food and farming.

So, if we stop farming, will this change what it means to be human?