What AI-driven optimisation means for the farmer

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Acknowledgment of Country

I would like to acknowledge the people of Ngāi Tahu upon whose lands we meet today. I would also like to acknowledge the Bunurong peoples of the Kulin Nation upon whose lands I live, work and play. I pay my respects to Elders both past and present.

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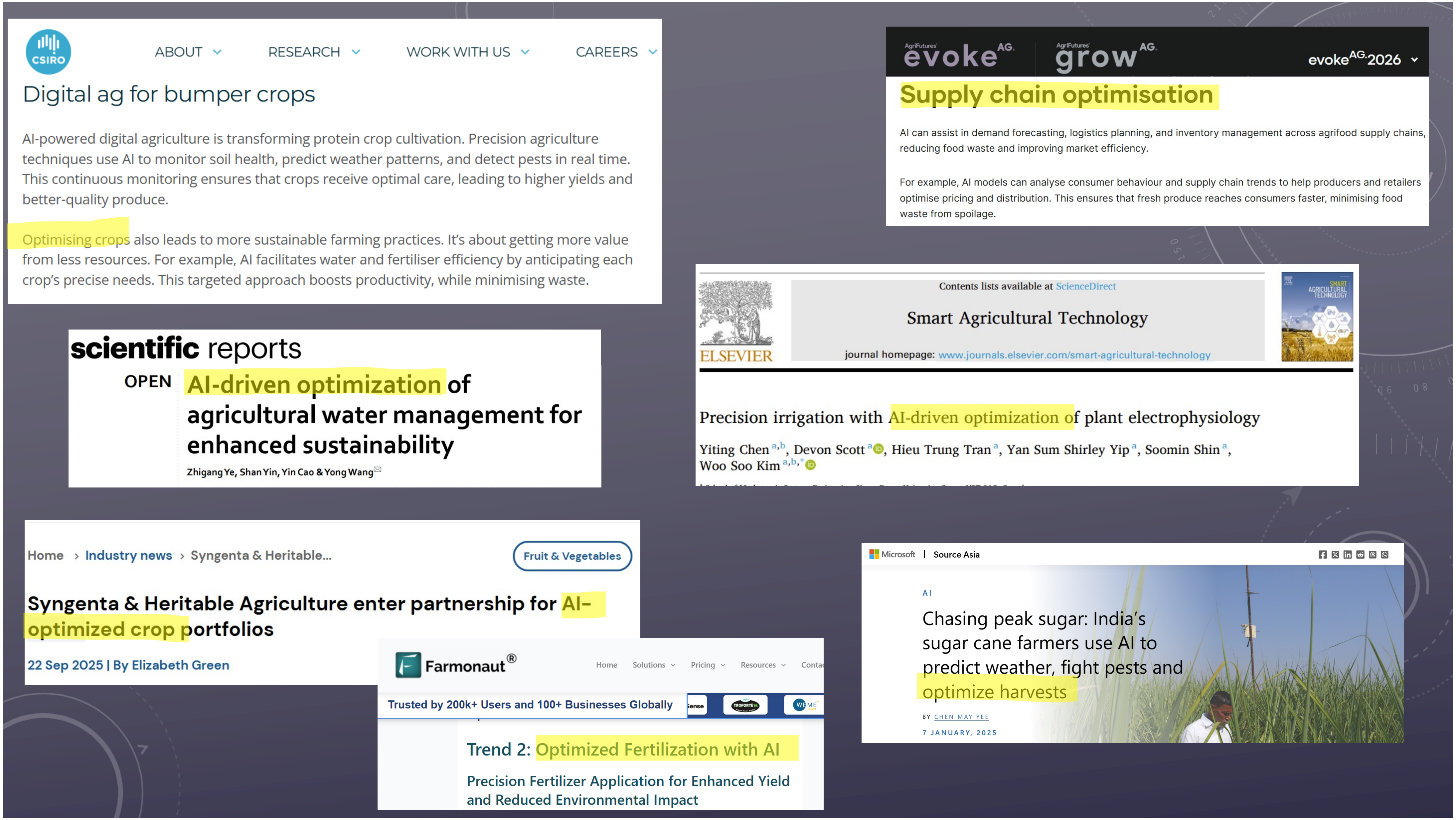
Artificial Intelligence, Robots, and Agriculture: Social and Ethical Issues (ARC DP220102952)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Digital ag for bumper crops
AI-powered digital agriculture is transforming protein crop cultivation. Precision agriculture techniques use AI to monitor soil health, predict weather patterns, and detect pests in real time. This continuous monitoring ensures that crops receive optimal care, leading to higher yields and better-quality produce.
Optimising crops also leads to more sustainable farming practices. It's about getting more value from less resources. For example, AI facilitates water and fertiliser efficiency by anticipating each crop's precise needs. This targeted approach boosts productivity, while minimising waste.
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Supply chain optimisation
AI can assist in demand forecasting, logistics planning, and inventory management across agrifood supply chains, reducing food waste and improving market efficiency.
For example, AI models can analyse consumer behaviour and supply chain trends to help producers and retailers optimise pricing and distribution. This ensures that fresh produce reaches consumers faster, minimising food waste from spoilage.
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AI-driven optimization of agricultural water management for enhanced sustainability
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AI
Chasing peak sugar: India's sugar cane farmers use AI to predict weather, fight pests and optimize harvests
BY CHEN MAY YEE
7 JANUARY, 2025

The technological landscape of Western agriculture

Agriculture 1.0 refers to a high degree of manual labour input with a relatively low productivity i.e the plough

Agriculture 2.0 gave rise to the 'Green Revolution' hallmarked by synthetic fertilisers, pesticides, and genetically modified seeds, which increased yields

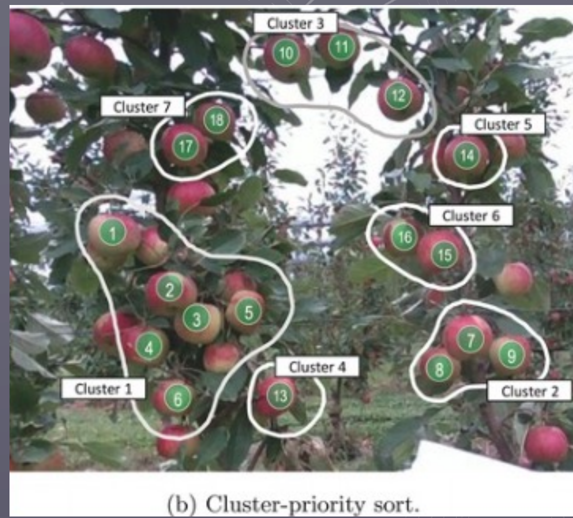
Agriculture 3.0 refers to farm management that uses technology to monitor and manage yields, also known as 'precision agriculture' i.e GPS, machinery, automation, and big data

Agriculture 4.0 refers to a shift towards 'digital' and/or 'smart' agriculture. An umbrella term for sophisticated robotics, data and artificial intelligence

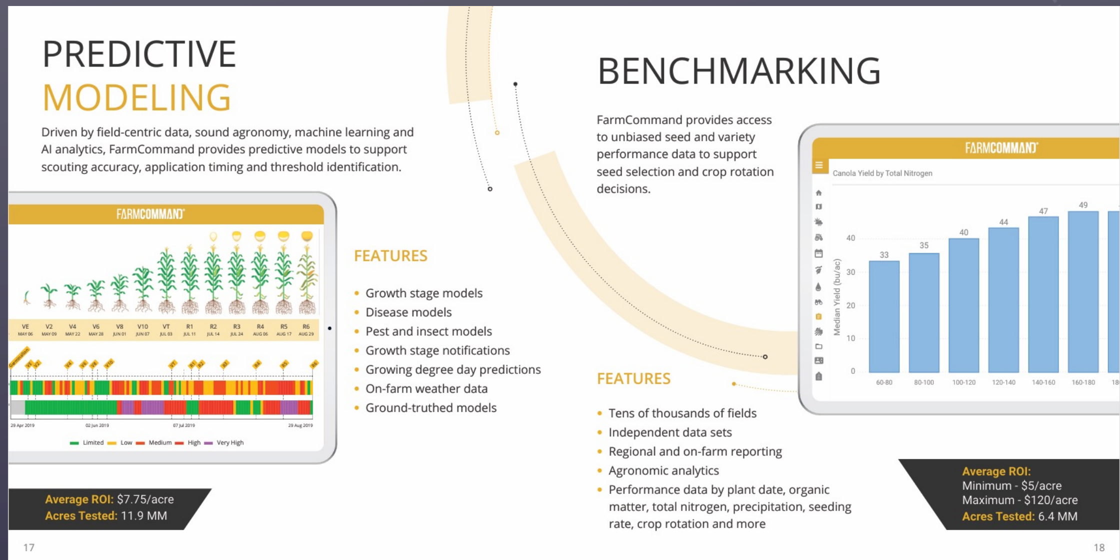
How is AI being used in agriculture?

Applications include:

- yield prediction
- harvest management
- automatic crop health change detection
- data-driven crop plans
- farm finance and administration
- AI-enhanced tractors
- sensor-equipped drones for monitoring and spraying
- agronomist support



Monash apple-harvesting robot (MARS), 2023



Farm Command, *Farmers Edge* (2022)

Value-laden metrics and measurements

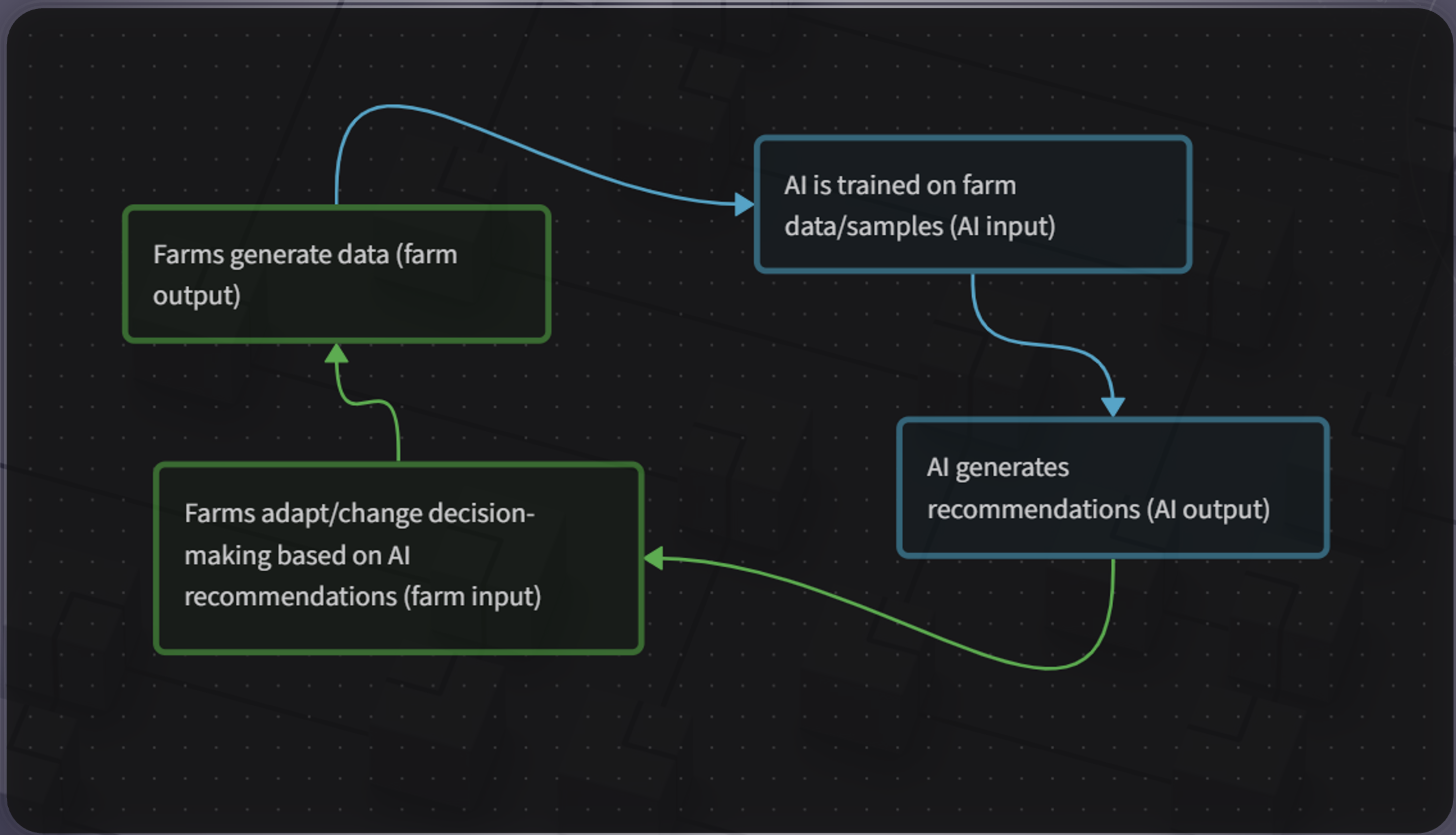
- Emphasis on yield and productivity metrics over ecological impact or biodiversity
- Quantifiable outputs prioritised over qualitative factors

Sampling and representation bias

- Over-representation of large-scale industrial farming operations
  - Farming enterprises with greater integration with the agricultural ‘value-chain’ will be in a better position to leverage benefits (Jakku et al, 2018; 2016)
- Under-representation of smallholder farmers

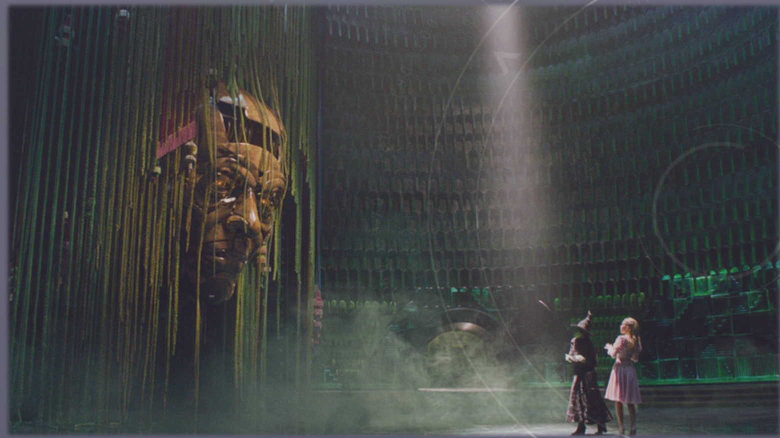
Algorithmic and technical biases

- Risk of amplifying existing inequities through automated decision-making
  - A ‘runaway feedback loop’ (Benjamin 2019)



The farm ‘runaway feedback loop’

The narrative of *optimisation*…



“The wizard will see you now!” *Wicked (2024)*

“an act, process, or methodology of making something (such as a design, system, or decision) as fully perfect, functional, or effective as possible.” (“optimisation." *Merriam-Webster.com*)

“…the design of a system that optimises a set of metrics subject to constraints.” (Kochenderfer and Wheeler 2025)

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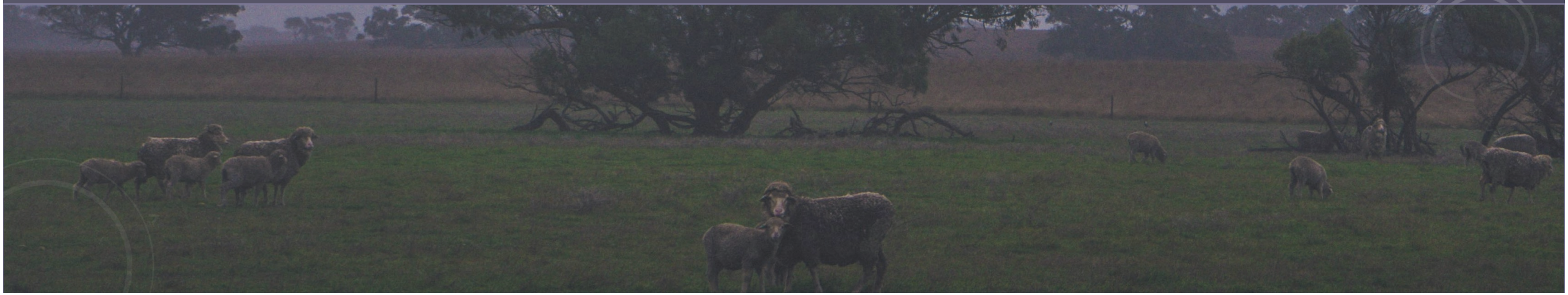
The narrative of *optimisation…*

“The problem is not measurement, but excessive measurement and inappropriate measurement—not metrics, but metric fixation.” (Muller 2018)

“Crucially, despite the correlation between water footprint and carbon footprint, the existing techniques that optimise for carbon efficiency do not necessarily equate to, and may even worsen, water efficiency… In other words, only focusing on AI models’ carbon footprint alone may be insufficient to enable truly sustainable AI.” (Li et al. 2023)

The *Good Farmer*

The *good farmer*, pursuant to the goal of producing food and fibre, has specific duties generated from the expectations of this role. To achieve these duties, they exhibit characteristics that are specific to the practice of agriculture. These characteristics are evaluated by practical and moral means, by farmers demonstrating a diverse range of qualities, skills and behaviours that meet a social or professional standard of competency (Helliwell et al. 2021).



The *Good Farmer*

Stewardship

- *The good farmer* is a steward of the land. They understand what the land needs and how it ought to be effectively managed, while working within its constraints (Berry 2009). They look after the soil for current and future generations.

Respect for ecosystems

- They understand ecological relationships and biological processes that contribute to their expertise in technical and embodied knowledge (Legun et al. 2022).

Wisdom

- Wisdom is reflected in *how* new technologies are adopted, including consideration of personal and professional values, identities and goals (Kuehne et al. 2017; Allen et al. 2017; see also Fleming et al., 2018). The *good farmer* also requires curiosity and creativity to approach unfamiliar or challenging agricultural work.

Key points:

- We need to be wary of *optimisation* narratives for how they conceal decision-making

- (1) Sampling and representation bias, (2) algorithmic and technical bias, and (3) value-laden metrics and measurements remain key ethical concerns for AI technologies in agriculture, and the future of farming

- The *good farmer* plays an essential role in agriculture, therefore they should be directly involved in the development and application of AI technologies – and any pursuit of farming 'optimisation'

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Data are not ‘value-neutral’

“The theory of technological politics draws attention to the momentum of large-scale sociotechnical systems, to the response of modern societies to certain technological imperatives, and to the all too common signs of the adaptation of human ends to technical means.” (Winner 1980)

“…instead of untouched by the human, agricultural big datasets and the computer instructions written to work with these data are the product of a myriad of decisions and specific practices and, as such, even the biggest datasets and the most “intelligent” machines are deeply entangled with human interests and values.” (Bronson 2022)

What does AI *afford* the future of farming?

"*Affordance* is a useful conceptual tool in such a project because it lets analysts interrogate the effects of emergent technologies while avoiding hard-line determinism." (Davis 2020, 7)