

1. Future of Agri Tech: Opportunities for Economists

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Abstract

Agriculture is changing quickly due to new technologies that collect, analyse, and use data. These tools help farmers use fewer resources and earn more, while also reducing pressure on the climate and the environment. However, technology alone cannot solve farming problems. Real progress depends on prices, policies, and how people make choices. That is where economists come in. They study adoption, incentives, and fairness in markets. This article explains how agri-tech is reshaping farming, how economists can guide these changes, and what skills they need to take part. It examines technology trends, economic barriers, risk and financial tools, and the importance of data rules.

1. Why Agri-Tech Matters Now

Farming today faces many limits. Land and water are scarce, populations are growing, and the climate is changing fast. Farmers need to produce more food, but must also protect the planet. Technology offers new ways to manage these pressures.

According to the Food and Agriculture Organisation (FAO, 2025), farming and food systems account for about one-third of

the world's greenhouse gas emissions—roughly 16.5 billion tons of CO₂ equivalent each year. Agriculture also uses about 70 per cent of all freshwater (World Bank, 2017). These numbers show that new technology can have a significant impact.

Sensors, satellites, and mobile tools can help farmers measure soil, plan irrigation, and reduce waste. However, the challenge is not only technical. Farmers will only adopt these tools if they make financial sense. That is why economists play a key role: they analyse costs, benefits, and how markets respond.

2. What Agri-Tech Includes

Agri-tech is a broad term. It includes tools, software, and systems that make farming more innovative and more efficient. These can be grouped into a few main areas.

Remote Sensing and On-Farm Sensors

Satellites and drones can monitor crops across large areas. Governments and insurers use this data to check yield and drought impacts. For example, satellite-based crop indexes are now used to process insurance claims faster and more accurately.

On-farm sensors measure soil moisture, temperature, and nutrients. These tools help farmers adjust irrigation and fertiliser use. However, their value depends on local conditions. In regions where the electricity or water supply is unreliable, sensors may not help much. Economists can analyse these cases to decide where investment gives the best return.

Artificial Intelligence and Decision Systems

AI models can predict weather, pests, and disease outbreaks. They help farmers decide when to plant or harvest. However, AI must be trained for local realities—soil type, crop variety, and risk preferences. Economists can translate this data into decisions that balance profit and risk.

Automation and Robotics

Robots now plant seeds, spray fields, and harvest crops. Automation can reduce labour shortages and boost productivity. However, it can also replace jobs. Economists can study how to manage this change so that benefits are shared fairly, and small farms are not left behind (FAO, 2022).

Market and Investment Growth

The precision-farming market was valued at about USD 11.6 billion in 2024 and could reach USD 24 billion by 2030 (Grand View Research, 2024). This growth opens new jobs for data analysts, policy experts, and

economists. However, technology success depends on adoption, not just innovation.

3. Adoption: The Real Challenge

Technology adoption is an economic decision. Farmers compare the costs and expected gains and consider risks. Even when a tool raises average income, it may increase uncertainty. For example, variable-rate fertiliser systems can improve efficiency but require a significant upfront investment and reliable data.

Economists can model these trade-offs. They can design credit systems, insurance, or cooperative models to spread risk. They can also study learning effects—how farmers observe each other and how trust affects adoption.

Small Farmers Matter

Most of the world's 570 million farms are small family farms (Lowder et al., 2016). Together they produce about one-third of the world's food (FAO, 2021). Many smallholders cannot afford expensive equipment or software. Economists can help design low-cost subscription models, leasing schemes, and training programs that fit local income levels.

Mobile coverage now reaches almost all regions, yet digital literacy remains uneven (GSMA, 2023). Economists can study how to close this gap through incentives, cooperative models, or public-private partnerships.

How Economists Add Value

Economists can:

- Estimate demand and willingness to pay for new tools.
- Design fair credit and insurance products.
- Evaluate actual impacts on income, labour, and the environment.
- Advise governments on where subsidies or training deliver the best value.

In short, they connect innovation to real-world behaviour.

4. Markets and Digital Platforms

Agri-tech is not just about production. It is also changing how farmers buy inputs and sell crops. Digital marketplaces and e-commerce platforms now connect farmers directly with buyers.

Better Price Discovery

Online platforms make it easier to compare prices and quality. They can reduce fraud and give farmers more choices. For perishable crops like fruits and vegetables, fast transactions can prevent waste.

However, these platforms can also create new risks. If one company dominates, it may set unfair fees or terms. Economists can measure such market power and help regulators design competition rules and data-sharing standards.

Cutting Post-Harvest Loss

FAO (2025) and UNEP (2024) report that about 14 per cent of food is lost before reaching retail, and more than 1 billion tonnes are wasted each year. Cold-chain technology and better storage can reduce these losses. However, many farmers sell immediately because they need cash. Warehouse receipt systems—where stored grain serves as collateral for loans—can help. Economists can design and test such systems.

Public Procurement and Standards

Governments can also drive adoption through public procurement and sustainability standards. When buyers demand traceability, they create markets for new technology. Economists can assess the costs and design policies that do not exclude smallholders.

5. Risk, Climate, and Finance

Farming is risky because of weather, pests, and price swings. New technology can help measure and manage these risks, but financial tools must adapt.

Weather and Index Insurance

Satellite data now supports insurance that pays farmers automatically when drought or flood indicators reach certain levels. This speeds up payouts and reduces fraud. However, the insurance must be accurate enough to match real losses. Economists help improve these indices and study

whether they actually raise investment and income (World Bank, 2024).

Carbon and Biodiversity Credits

Farmers can earn income from climate action by storing carbon in soil or by reducing methane emissions. However, carbon markets require trustworthy measurement, reporting, and verification (MRV) systems. Economists design rules to ensure that credits are honest and fair, and that smallholders are not left out.

Water Use and Efficiency

Agriculture accounts for about 70 per cent of global freshwater use. Efficient irrigation can save water and energy, but adoption depends on pricing. If water is too cheap, farmers have no reason to conserve. Economists can create pricing or trading systems that reward savings while protecting poor farmers (UNESCO, 2024; World Bank, 2017).

6. Data and Regulation

Data is now a key input in farming. It helps make better decisions, but it also raises questions about privacy, ownership, and fairness.

Who Owns Farm Data?

Farmers often share data with equipment makers or digital platforms without knowing how it is used. Economists can help design contracts or cooperatives that protect data rights and ensure value sharing.

Interoperability and Competition

When data systems are closed, farmers get locked into one company's tools. This can reduce competition. Economists can support open-data standards and advise regulators on fair competition.

Automation and Employment

Automation can raise productivity but may reduce rural jobs. Economists can estimate which skills are at risk and how training or shared-service models can support a fair transition (FAO, 2022).

7. Conclusion

The future of agri-tech depends not only on engineering but also on economics. Every tool—whether a sensor, a drone, or a digital platform—succeeds only if it fits human behaviour, markets, and policy.

Economists have four main tasks in this transformation:

1. **Understand real decisions.** Farmers adopt tools only if they make sense for their risk level, credit access, and local prices.
2. **Measure real outcomes.** Yields matter, but so do profits, stability, and environmental gains.
3. **Build fair markets.** Economists design rules for carbon, data, and water so that benefits reach small farms.
4. **Guide social transition.** They study how automation and

digitalisation affect labour and income, and how they help governments plan education and safety nets.

By combining data analysis with knowledge of human behaviour, economists can make agri-tech both profitable and fair. The coming decade will need economists who work with engineers, agronomists, and policymakers to turn ideas into lasting change.

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