

Beyond Technology: Why Farmer Behaviour Matters in Agricultural Development

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Introduction

Agricultural development is often described through the language of technology: improved seed, precision farming, drones, mobile applications, climate-smart practices, artificial intelligence and digital advisory services. These innovations can undoubtedly improve productivity, resource-use efficiency and farmers' access to information. Yet a technology does not create development simply because it exists. Its benefits emerge only when farmers understand it, trust it, can use it, perceive it as useful and are willing to integrate it into their everyday decisions. The central question, therefore, is not only "What technology should agriculture provide?" but also "What makes a farmer willing and able to use it?"

Technology adoption is fundamentally a behavioural process. The Food and Agriculture Organization has long described extension impact through a sequence in which awareness and knowledge contribute to adoption and, ultimately, productivity. Adoption is therefore not a single event but a process involving learning, evaluation, trial and continued use. Recent evidence from India reinforces this perspective. A 2026 randomized controlled trial involving 1,006 farmers found that periodic text-message reminders increased adoption of a smartphone-based agricultural application, illustrating how a relatively simple behavioural intervention can complement technology itself (Reddy *et al.*, 2026a).

This article argues that the next phase of agricultural development should move from a technology-centred approach towards a farmer-centred approach, where behavioural realities are treated as an essential part of innovation design, extension and policy.

Technology alone is not adoption

A common assumption is that once farmers receive information about a useful innovation, adoption will follow. In reality, farmers make decisions under uncertainty. They consider the cost of the technology, expected returns, risk of failure, labour requirements, compatibility with existing practices, availability of inputs and services, and the experiences of other farmers. A technology may be scientifically superior but still be rejected if it appears expensive, complicated or risky. The adoption decision is also influenced by psychological factors. Perceived usefulness, confidence, attitudes, trust and perceived ease of use can determine whether a farmer moves from awareness to actual use. Recent work in India on ICT-based agro-advisory services

identified perceived usefulness, trust and credibility, accessibility and convenience, responsiveness and personalisation, adoption behaviour and general attitude as important dimensions for understanding farmers' attitudes towards digital advisory services (Paliwal *et al.*, 2025).

Figure 1. Behavioural pathway linking agricultural



technology with sustained farm outcomes.

The farmer is a decision-maker, not merely a technology user

Farmers continuously compare new recommendations with their previous experiences and local realities. A farmer may ask: Will this work on my soil? What happens if rainfall fails? Can I afford the initial investment? Who will repair the equipment? Will the market reward the additional production? What do other farmers in my village think? These questions demonstrate that technology adoption is embedded in a wider social and economic environment.

Social networks are particularly important. Farmers often learn by observing neighbours, relatives, progressive farmers and local leaders. Interestingly, recent evidence from Andhra Pradesh shows that social networks can influence technology adoption in complex ways. Reddy (2026) found that farmers' positions within village networks mattered for smartphone adoption, suggesting that extension programmes may benefit from identifying well-connected farmers as information-diffusion nodes. At the same time, peer effects do not always accelerate adoption; the effect can depend on what the technology is used for and how information circulates. This means that extension strategies should not treat a farming community as a collection of isolated individuals. Farmers are part of networks of trust, information and social influence.

Trust: the invisible infrastructure of agricultural innovation

Trust is one of the most overlooked components of agricultural technology adoption. Farmers receive recommendations from many sources—extension personnel, input dealers, private companies, mobile applications, social media, fellow farmers and family members. The credibility of the source can influence whether information is accepted and acted upon.

Trust becomes especially important when technologies involve unfamiliar digital platforms, financial commitments or recommendations that may affect crop yield. A farmer who does not trust the information source may ignore a technically accurate recommendation. Conversely, a trusted extension worker or respected farmer can reduce uncertainty and encourage experimentation.

Recent research on digital agriculture in rural India similarly highlights trust, perceived risk, social influence, digital literacy, affordability and enabling conditions as interconnected elements of technology adoption. This reinforces the idea that digital transformation is not simply a matter of installing infrastructure; it requires building human and institutional capacity around that infrastructure.

From awareness to sustained behaviour change

Agricultural extension has traditionally played a major role in moving innovations from research stations to farming communities. However, the role of extension must evolve with changing technologies. It is no longer enough to demonstrate how a technology works. Extension should help farmers understand why it matters, assess whether it fits their situation, practise its use, solve problems during implementation and evaluate outcomes.

Behavioural interventions can make this process more effective. For example, reminders, demonstrations, peer learning, local champions, personalised advisories and timely feedback can reduce the gap between intention and action. In the 2026 Indian field experiment by Reddy *et al.*, periodic text reminders increased adoption of an agricultural mobile application; greater engagement with the application was also associated with improved crop prices and lower expenditure on selected inputs. Such findings show that small behavioural supports can strengthen the impact of larger technological investments.

Table 1. Behavioural factors influencing agricultural technology adoption

Behavioural factor	How it influences adoption	Possible extension response
Perceived usefulness	Farmer judges whether the technology solves a real problem.	Demonstrate locally relevant benefits and economic returns.
Trust and credibility	Confidence in the source affects acceptance of advice.	Use trusted extension personnel, farmer groups and transparent evidence.
Perceived risk	Fear of crop or financial loss can	Promote small-scale trials,

	delay experimentation.	demonstrations and risk-management support.
Digital literacy	Ability to navigate devices and platforms affects effective use.	Provide hands-on training in local language and simple formats.
Social influence	Peers and local networks shape expectations and decisions.	Use farmer-to-farmer learning and locally respected champions.
Self-efficacy	Confidence in performing a new practice supports continued use.	Offer repeated practice, follow-up and troubleshooting.

Co-designing technology with farmers

One of the strongest ways to make innovation farmer-centred is to involve farmers before the technology is finalised. Farmers can identify practical constraints that may not be visible to researchers or developers. Language, interface design, timing of advisories, local cropping systems, labour availability and the format of information can all determine whether a technology becomes useful in practice.

A participatory study of a mobile agricultural advisory system in Maharashtra illustrates this approach. Researchers examined behavioural determinants such as norms, trust, abilities and attitudes and then used repeated feedback from farmers to refine the advisory tool. Features such as multilingual support and alternative text and audio-visual communication were incorporated to improve usability and trust. Such approaches transform farmers from passive recipients into partners in innovation.

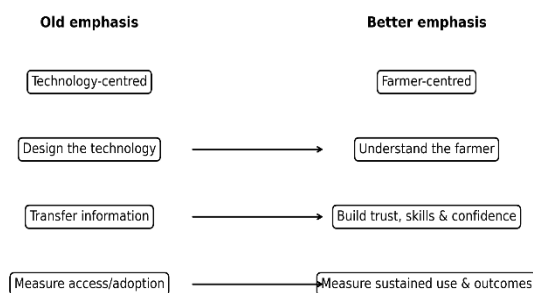


Figure 2. Shifting from a technology-centred to a farmer-centred approach.

What agricultural development programmes should do differently

A farmer-centred approach does not mean rejecting technology. Rather, it means designing technology around real human behaviour. Development programmes can begin

by diagnosing the reasons for non-adoption instead of assuming that farmers are unwilling to change. The key questions should include: Is the technology affordable? Is it compatible with existing practices? Do farmers trust the information? Do they have the skills to use it? What social norms influence the decision? What happens after the first trial?

Extension programmes should also measure more than distribution and initial adoption. Installing an application, purchasing equipment or attending a training programme does not necessarily mean that the technology is being used effectively. Indicators of sustained use, correct application, farmer satisfaction, confidence, productivity, profitability and resource efficiency provide a more meaningful picture of development impact.

Table 2. Technology-centred versus farmer-centred agricultural development

Dimension	Technology-centred approach	Farmer-centred approach
Starting point	Technology or innovation available	Farmer problem and local context
Communication	One-way transfer of information	Dialogue, feedback and co-learning
Adoption	Focus on initial uptake	Focus on sustained and effective use
Extension role	Technology demonstrator	Facilitator, coach and problem-solver
Success measure	Reach, distribution or adoption	Use, outcomes, confidence and livelihood benefits
Innovation design	Designed mainly by experts	Co-designed with farmers and stakeholders

Conclusion

The future of agricultural development will certainly involve more technology—but successful development will depend on more than technology. Drones, sensors, mobile applications, artificial intelligence, improved varieties and precision tools can create opportunities, but farmers decide whether, when and how those opportunities become part of everyday agriculture. Understanding farmer behaviour therefore needs to move from the margins of agricultural development to its centre. Attitudes, trust, perceived risk,

social influence, skills, confidence and local experience are not secondary issues; they are part of the adoption environment. Agricultural extension has a critical role in connecting technological possibilities with human realities.

The most effective agricultural innovation is not necessarily the most sophisticated technology. It is the innovation that farmers can understand, trust, afford, use and sustain. In other words, the pathway to smarter agriculture begins not only with smarter technology, but with a deeper understanding of the farmer.

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