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Empowering India's 89% marginal farmers through AI innovation

PREMIUM

AI is propelling India's rural producers towards a more secure, sustainable, and prosperous future

By Prashant Sharma

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Agriculture remains the backbone of India's economy, employing nearly 45 per cent of the workforce and contributing around 15-18 per cent to GDP, with foodgrain production exceeding 330 million tonnes annually to feed 1.4 billion people along with exports. A significant part of this production comes from farmers who operate in less than 2 hectares of land (about 5 acres, typically 1-2.5 acres in practice), referred to as marginal farmers. Despite operating in tiny plots, they are able to contribute significantly because they constitute over 89 per cent of agricultural households and more than half of the farming workforce.

However, these small landholders grapple with challenges specific to them, such as low yields, unpredictable climate risks, limited market intelligence, and dependence on intermediaries, often lacking access to timely advisories or quality testing. That's a gap AI can fill with its transformative power by delivering scalable, low-cost tools via basic smartphones, feature phones, and technical assistance. Therefore, AI solutions can help empower the core farmers of our nation to enhance their produce and ensure better returns through solutions aiding weather forecasting, pesticide use, etc.

Real-time decision support

AI systems integrate massive amounts of real-time data from weather forecasts, soil sensors, and satellite imaging, rendering agricultural advisories precise and actionable. Tools providing Agricultural Monitoring & Event Detection (AMED) API deliver real-time, field-level insights into crop health, irrigation needs, and planting schedules, enabling marginal farmers to anticipate weather-driven risks, optimise resource use, and boost productivity on very small holdings. Such tools democratise access to information previously available only to well-resourced farmers, promoting inclusion and equity.

Increasing yields and reducing input costs

Recent pilot projects and scalable AI-driven platforms have demonstrated the ability to directly increase crop yields for marginal farmers. In Telangana's "Saagu Baagu" initiative, AI-powered mobile advisory tools for chilli farmers resulted in a 21 per cent rise in crop yield per acre while reducing pesticide use by 9 per cent and fertilizer expenditure by 5 per cent. Net income per acre in these projects surged by $800 in a single crop cycle, reflecting not just short-term viability but long-term transformation potential. These data-driven interventions empower farmers to make better decisions about soil management, pest control, and crop selection without dependency on local intermediaries.

AI-based foodgrain quality testing and post-harvest solutions

One key innovation is the AI/ML-powered Quality Check application that can give farmers a quality assessment of their produce in a matter of minutes. Along with this came "Crop Quality Check Centres" — physical and digital grain testing centres established to bring rigorous quality checks to marginal farmers at an affordable price. Until recently, farmers had to rely on NABL labs to get their produce quality tested, which cost them precious time and resources. This resulted in many getting their produce valued roughly by people in mandis referred to as 'Arthias'. With the rapid scaling process, hundreds of AI-powered centres bridge this gap, granting small farmers, FPOs, and local traders access to real-time quality analysis.

This boosts negotiation power and ensures fair prices in the market, reducing post-harvest losses and saving farmers' valuable resources.

Supporting climate resilience

Accurate prediction of rainfall, pest outbreaks, and crop health enables marginal farmers to adapt to climate change. AI-led advisories have helped millions of farmers in India postpone planting dates or switch crops in response to monsoon variability, reducing vulnerability to erratic weather. The ability to plan and respond dynamically to climate signals can mean the difference between profit and loss for those with limited resources.

Government and industry partnerships

India's agricultural transformation hinges on robust collaboration between the public and private sectors. The government's "Vision 2023 for AI in Agriculture" has set the groundwork for integrating cutting-edge artificial intelligence tools to enhance productivity, sustainability, and farmer livelihoods. This initiative is more than a policy document; it's a clarion call for ecosystem stakeholders to unite around innovation, with a clear focus on reaching the millions of marginal farmers who stand to benefit the most.

Central to realising this vision is the adoption of the Three Pillared IMPACT AI framework:

- Infrastructure and Accessibility: Building digital infrastructure and ensuring affordable AI-driven tools reach even the remotest villages, so that smallholders are not left behind.
- Market Linkages and Monetization: AI-powered platforms can intelligently connect farmers to markets, streamline commodity pricing, and reduce post-harvest losses, empowering them to capture more value from their crops.
- Capacity Building and Trust: Partnerships must invest in farmer education, hands-on training, and continuous support to demystify digital technologies and foster trust in AI, ensuring adoption at scale.

A forward-thinking approach demands that both government agencies and the AgTech industry move beyond siloed pilot programmes, toward co-creating scalable, inclusive solutions. As AI matures, competitive advantage will rest with those actors who jointly invest in solutions that are interoperable, data-rich, and built for India's unique diversity. For India to meet the promise of Vision 2023, partnerships must be dynamic, collaborative, and driven by the shared goal of empowering marginal farmers at every step of their agri-journey.

Inclusive financial aid and risk reduction

AI is also being deployed by the government to enhance the targeting of direct financial aid schemes, such as PM-Kisan, ensuring money reaches only eligible marginal farmers. Through large-scale data analytics and integration of Aadhaar, income, and landholding records, inefficiencies and leakages are minimised, strengthening the social safety net for millions.

Future prospects

As more affordable, vernacular-language AI platforms proliferate, digital literacy and internet penetration rise, positioning India's marginal farmers to benefit at scale. Agricultural AI software is expected to empower even the smallest farm with digital decision-making tools, optimise water usage, and maximise yields, while also building reliable risk management systems resilient to climate disasters.

In sum, AI offers a multifaceted path forward for marginal farmers by integrating scalable technology with the realities of the field. Through productivity gains, reduced input costs, post-harvest efficiency, and expanded market access, AI is propelling India's rural producers towards a more secure, sustainable, and prosperous future.

(The author is CTO, Sohan Lal Commodity Management Limited)