

Data-Driven and AI-Enabled Agricultural Advisory Systems and Their Impact on Productivity, Sustainability, and Livelihoods: Evidence from Smallholder Farmers in Vidarbha, India

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Abstract

The integration of Artificial Intelligence (AI) and data-driven technologies into agricultural advisory systems has the potential to fundamentally transform the agriculture sector. In India, where agriculture supports nearly 45% of the labour force but contributes only about 17% to the national GDP, productivity remains constrained by fragmented landholdings, dependence on rainfall, and limited access to reliable agronomic information. Traditional agricultural extension systems often fail to deliver timely and personalized advisories. The emergence of AI-enabled, data-informed agricultural platforms represents a major leap toward sustainable, knowledge-based farming. This study investigates how AI-driven agricultural advisory services influence productivity, sustainability, and livelihood outcomes in the Amravati Division of Maharashtra. A survey of 500 farmers was complemented by interviews with 33 stakeholders, including representatives from Farmer Producer Organizations (FPOs), government departments, and Ag-Tech firms. Statistical analysis and coding techniques were used to explore both quantitative and perceptual dimensions of technology adoption. A majority of farmers adopted at least one Ag-Tech tool, including AI-based mobile advisory services, smart irrigation systems, and digital soil-testing kits. Education level, landholding size, and FPO membership were significantly associated with adoption rates. Adopters reported an average yield increase of 22.3%, a 15.6% reduction in input costs, and over 50% improvement in irrigation efficiency. Qualitative insights revealed that FPOs acted as trust anchors, facilitating technology demonstrations, training, and group-based procurement, while peer influence and perceived usefulness encouraged continued engagement. However, barriers such as low digital literacy and connectivity gaps persist. The study concludes that data-driven and AI-enabled advisory systems enhance farm productivity, profitability, resilience, and social awareness. The long-term success of Ag-Tech adoption depends not only on technological innovation but also on institutional design and trust-building mechanisms within farming communities.

Keywords

AI-Enabled Agriculture, Digital Advisory Systems, Agricultural Technology Adoption, Farmer Producer Organizations (FPOs), Smallholder Livelihoods, Sustainability and Climate Resilience, Data-Driven Decision Support, Vidarbha, Maharashtra, Mixed-Method Analysis.

