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AI- ENABLED CLIMATE ADVISORY SERVICES: A NEW FRONTIER IN AGRICULTURAL EXTENSION

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1. Introduction

A farmer deciding when to sow is also making a decision about the weather: Will the rain arrive on time? Will it last? Is there enough moisture in the soil to risk planting? For smallholder farmers, getting those decisions wrong can mean losing a season's work.

Agricultural extension services have long helped farmers make such choices. But extension workers often serve large areas, and advice may not reach every farmer when it is needed. Meanwhile, climate conditions, crops, soils and resources vary from place to place. A recommendation that works for one village may not fit the next.

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Artificial intelligence (AI), mobile phones and climate data are opening new ways to deliver timely, locally relevant advice. Together, they could help extension services reach more farmers and respond to their questions as conditions change.



From forecasts to farm decisions

Weather forecasts and climate information are useful only when people can act on them. A prediction of below-normal rainfall, for example, matters when it helps a farmer decide whether to prepare land, wait to sow, or consider a different crop.

A study of the iSAT advisory system in Anantapur district, Andhra Pradesh, shows how this connection can work. Over three cropping seasons, the system combined seasonal forecasts, recent weather and short-range forecasts with agricultural knowledge. It sent farmers weekly text messages with guidance for decisions such as land preparation, sowing and harvesting.

The study involved 720 farmers. In the climate-informed villages, farmers reported using the advisories to guide decisions on harvesting, sowing and land preparation. The authors also reported crop productivity increases ranging from 1% to 56% compared with uninformed villages. These results varied by season and location, and the study notes that forecasts can differ from what actually happens. The useful lesson is not that an advisory guarantees a better harvest; it is that timely information can help farmers adjust as the season unfolds.

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A conversation, not just a message

AI-powered chat services add another possibility: farmers can ask questions in their own words and follow up when they need more detail. Instead of receiving only a scheduled message, a farmer might ask about a crop symptom, a pest, or whether current weather conditions make a planned activity risky.

The Farmer Chat paper describes a generative AI service designed to provide agricultural information through natural-language conversations. It draws on agricultural knowledge sources and supports multiple languages and formats, including text, audio and video. The paper reports deployment in four countries, with more than 15,000 farmers engaged and over 300,000 queries answered. Its evaluation found that the system successfully answered more than 75% of queries.

Those figures point to potential reach, but they should be read carefully. A chatbot answering a question is not the same as a farmer adopting the advice, improving a harvest or increasing income. Those outcomes depend on many things: whether the information is correct for the farmer's location, whether the recommended seed or input is affordable and available, and whether the farmer trusts the source.

Combining AI with local knowledge

The strongest advisory services are likely to combine several ingredients: reliable weather and climate information, sound agricultural research, local expertise and farmers' own experience. AI can help organize this information, make it easier to access and tailor responses to a conversation. Extension workers can help interpret complex situations, build trust and provide support when the system does not know enough.

This partnership matters because farms are not interchangeable. Advice can depend on crop variety, soil, planting date, water availability, local pests and the resources a household can use. Climate forecasts are also uncertain. A good advisory should explain what is expected, how confident the forecast is, and what farmers might do under different conditions.

Access must be designed in

Digital services can reach people who are far from an extension office, but access is not automatic. Farmers may have limited connectivity, expensive data, shared phones or difficulty reading long messages. A service that relies on text alone may leave some people out.

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Voice options, local languages, short messages and accessible audio or video can help. So can involving farmers and extension workers in designing and improving the service. That makes it more likely that the advice reflects local needs and is understandable in practice.

Privacy and accountability also matter. Farmers should know what information a service uses, how it handles their questions and who is responsible when advice causes harm. Systems need a clear way to flag uncertain or high-risk cases and connect users with a qualified person.

A new tool for a changing climate

AI-enabled climate advisory services will not replace extension workers, and they cannot remove the uncertainty of farming. Their promise is more practical: help deliver relevant information at the moment a decision needs to be made, in a form farmers can use.

The next frontier is not simply putting more AI into agriculture. It is building advisory services that join useful climate information with local knowledge, human support and accessible communication. When those pieces work together, a forecast can become more than a prediction. It can become a better-informed choice in the field.

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