



Irrigation system sensors are an important innovation in modern agricultural technology, enabling the monitoring and collection of key agri-environmental data such as soil moisture, temperature, nutrient content. PHOTO/COURTESY

Why cooperative farming could unlock autonomous agriculture

Cooperative farming also creates a space for farmers to work closely together while exchanging ideas and sharing practical knowledge about new technologies.

BY DAPHINE NAKABIRI

In Kigumba, Moses Ali Akiki, a farmer, has seen his maize crops dry up at the flowering stage following months of persistent dry spells.

While he lacks the irrigation technology to regulate water use and also respond to changing weather patterns, like thousands of smallholder farmers across Uganda, he still depends on instinct and manual labour.

In essence, his experience reflects a wider challenge facing Ugandan agriculture, where farming remains dependent on experience and trial-and-error rather than data-driven insight, limiting productivity and placing the country's food security under growing strain.

Yet as climate risks intensify and traditional methods prove increasingly inadequate, agricultural experts are pointing to emerging technologies designed to help farmers manage uncertainty as a

potential game changer.

What is autonomous agriculture?

This refers to the use of technology-driven systems that enable farming activities to be carried out with minimal human intervention, guided instead by data collected from the field.

These include sensor-based irrigation systems that release water when soil moisture is low, GPS-guided tractors that plant and weed with precision, drones that monitor crop health from the air, and digital platforms that analyse weather, soil, and crop data.

These systems are designed to support farmers helping to reduce guesswork, improve efficiency, and respond to changing environmental conditions in real time. In Uganda, however, the use of autonomous agriculture remains largely untapped and limited.

Whereas many farmers in Uganda operate small plots, most still rely on hand tools or basic mech-

anised equipment, and access to high-tech solutions is restricted.

For instance, advanced machinery such as GPS-guided tractors, drones, and sensor-based irrigation systems carry steep upfront prices that are simply out of reach for the majority of smallholders. Even when leasing models or cooperative ownership exist, limited access to credit and uncertainty about returns make many farmers hesitant to invest in technologies they have yet to experience in practice.

Further still, the skills and knowledge gaps also remain another major obstacle. This is because operating autonomous equipment requires familiarity with software, data interpretation, and routine troubleshooting. For many farmers, especially those in rural areas, such technical literacy is limited.

Extension services that could provide training are often understaffed or inaccessible, leaving farmers to rely on traditional methods, a practice that limits

productivity and reinforces dependence on manual labour.

The adoption of autonomous agriculture is also complicated by the level of infrastructure development in the country.

Reliable electricity, internet connectivity, and passable rural roads are essential for maintaining and operating autonomous systems, yet these are often inconsistent or absent in many farming regions.

Additionally, limited awareness and understanding of emerging technologies has created hesitation among farmers, with underdeveloped regulatory and policy frameworks to guide safe use and support automation. As a result, autonomous agriculture remains largely confined to pilot projects and commercial farms rather than being widely adopted across the country.

Cooperative farming

Although these challenges make it difficult for small-scale farmers to benefit from autonomous technologies, cooperative farming emerges as a promising strategy to unlock access to autonomous agriculture. It includes forms such as formal registered farmer groups and informal clusters that jointly manage equipment and technology.

At its core, cooperative farming means that farmers join forces to pool their resources, share costs, and collectively invest in machinery and digital tools.

According to Patrick Honcoop, an agronomy tech expert, farmers who have embraced this approach are able to purchase or hire modern, data-driven farming tools making them available to farmers who otherwise could not afford or manage them on their own. This, in turn, allows them to improve efficiency, reduce individual financial risk, and collectively boost crop productivity,

benefits that would be difficult to achieve alone.

Cooperative farming also creates a space for farmers to work closely together while exchanging ideas and sharing practical knowledge about new technologies. As such, through collaborating, farmers can support one another in learning how to operate machinery, interpret data from sensors or drones, and troubleshoot challenges that may arise in the field. This collective approach not only reduces the financial and operational risks that each farmer would face alone, but also opens the door to training opportunities that might otherwise be inaccessible.

He says, "For smallholders with limited land, working as a group makes high-tech farming sustainable, turning once unattainable tools into shared assets that benefit everyone in the cooperative."

Alternatives

Beyond cooperative farming, in a bid to make autonomous agriculture a reality across Uganda, this requires coordinated action by farmers, government, and private-sector players. One critical step is expanding access to affordable credit and financing tailored to smallholder farmers, enabling them to invest in machinery, sensors, and digital tools without shouldering the full cost upfront. This can be achieved through government-backed subsidies, low-interest loans, and public-private partnerships designed to reduce financial risk. Such measures can help lower the economic barriers that currently keep most farmers locked out of high-tech agricultural solutions, paving the way for wider adoption and long-term productivity gains.

Capacity building and technical training are another critical pillar in scaling autonomous agriculture. For farmers to effectively adopt these innovations, they need practical, hands-on guidance on how to operate autonomous systems, interpret data generated by sensors or drones, and carry out basic equipment maintenance.

In this regard, building partnerships with agricultural technology companies, strengthening extension services, and establishing local training centres can help bridge the skills gap by equipping farmers with the confidence and knowledge needed to use these tools effectively. This approach increases the likelihood of full adoption, rather than technologies remaining underutilised due to limited technical understanding.

Whereas infrastructure and connectivity continue to lag in many rural areas, improvements in these systems are essential. Reliable electricity, stable internet coverage, and accessible rural roads are prerequisites for operating and maintaining autonomous farming technologies.

With growing demand for more sustainable agricultural practices, investments in solar-powered solutions, expanded mobile networks, and improved rural logistics can help overcome these structural barriers. Such interventions would ensure that technology-driven farming systems remain functional, reliable, and accessible to farmers beyond urban centres and commercial hubs.

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