



# Transforming agriculture with digital automation

## State of digital automation in agriculture

The world is in the early stages of a wave of digital automation technologies in agriculture, which provide the backbone of precision agriculture (a means of site-specific farm management that improves yields while reducing input use). These technologies have great potential to improving agricultural productivity as well as environmental sustainability. They can also mitigate risk and improve farmers' wellbeing through e.g. increased income, reduced workload and increased flexibility in work schedules. Many of these advantages are driven by the capacity to automate one or more phases of agricultural operations including diagnosis, decision-making and performing (differently from traditional mechanization that automates only the performing phase).

These technologies can enable producers to precisely apply inputs where and when needed, thus maximising resource-use efficiency, saving costs and reducing negative environmental impacts. Being generally smaller in size (e.g. swarm robots) in comparison to traditional large-scale machinery, they also have lower impact in terms of soil compaction. They can also benefit consumers as they can expand the production of nutrient-dense crops, which are currently difficult to mechanize.

Furthermore, digital technologies have the potential to boost agricultural advisory services for small-scale producers. In fact, in low-income countries, the most frequently deployed digital solutions are disembodied digital tools (e.g. smartphones with advisory apps) due to their low cost and potential impacts on productivity and environmental sustainability.

However, differently from motorized mechanization, these technologies are relatively new and vary widely in their readiness for implementation. Figure 1 shows the four stages of readiness to scale of each technology based on 27 case studies worldwide. Solutions at the maturity stage mostly relate to livestock automation and crop farm digitalization. Most, however, are still scaling.

Solutions still at the 'close to market' or prototype stages mostly include advanced automation and robotics for both field



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## KEY MESSAGES

- ▶ Digital automation technologies have great potential to enhance the precision of agricultural operations, improve working conditions, and address environmental challenges, while building resilience to shocks and stresses.
- ▶ Adoption has been slow as most technologies are still relatively new and costly, especially for low- and middle-income countries, where poor connectivity and energy supply, and limited human capacity further hinder adoption.
- ▶ Incentivizing uptake requires creating a conducive business environment and suiting technologies to local conditions, especially to small-scale agriculture.

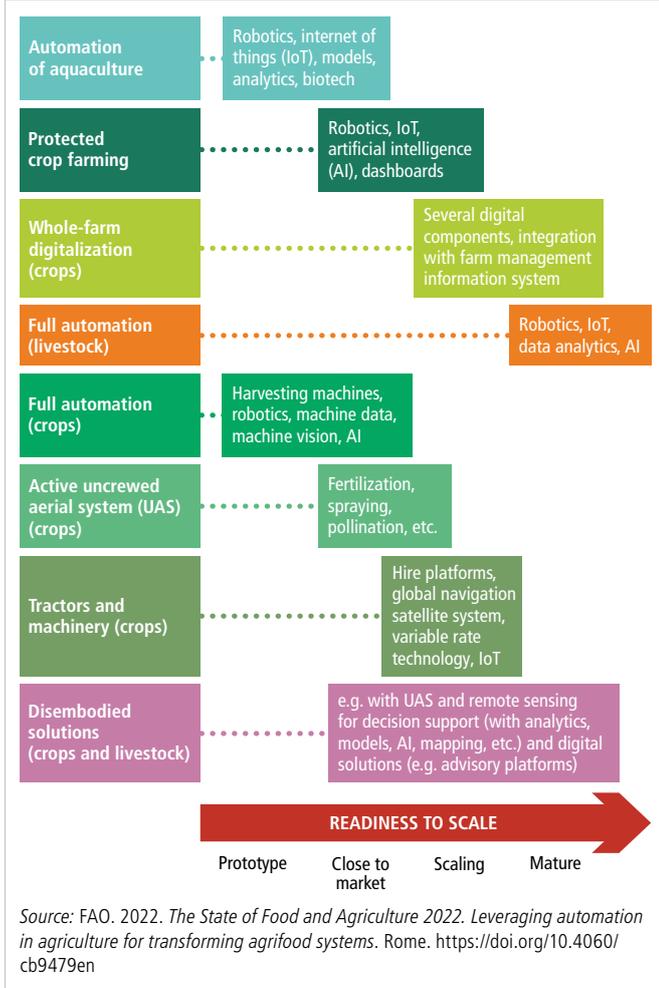
and protected agriculture, as well as aquaculture, in addition to uncrewed aerial systems (UAS, commonly known as drones) for input application.

And while the use of these technologies is growing, it is mostly happening in high-income countries. In low- and middle-income countries, structural constraints – such as related to connectivity and electricity – and a lack of a conducive business environment hinders adoption. To reap the full potential of these technologies, policymakers need to first, address structural barriers to adoption through the creation of an enabling environment, and second, harness the potential of these technologies for small-scale agriculture.

## Important areas of focus to create an enabling environment for digital automation

The extent to which digital automation can contribute to more efficient, productive, inclusive, resilient and sustainable agriculture greatly depends on the existence of a conducive

FIGURE 1. The readiness to scale of digital automation technologies along a spectrum



business environment in which digital automation technologies can flourish. Depending on the context, governments should prioritize actions, such as:

- **Investing in energy infrastructure.** No digital technology works without electricity. Policies that improve electricity supply and harness the potential of renewable energy (e.g. through off-grid electricity from renewable resources) are essential for the uptake of digital automation technologies.
- **Improving communications infrastructure.** Poor connectivity is widespread in many low- and middle-income countries, but also affects some rural areas in high-income countries. Policies encouraging the development of rural digital infrastructure are thus needed.

- **Building skills and human capacities.** An agenda to build human capacity, particularly with investments to scale digital skills through education and training among all relevant actors, is essential for facilitating adoption and avoiding digital divides.
- **Transparent national data policies and legislation** to facilitate the building of trust among farmers. In particular, clear rules concerning ownership and control of data are needed, as well as the development and support of national data infrastructure.
- **Investing in applied research and development.** Governments should fund research on technical, agronomic and economic solutions for locally adapted and sustainable automation. All relevant stakeholders should be engaged so that development processes take into account their concerns, needs and knowledge and thus result in contextually appropriate solutions.

## Harnessing digital automation technologies for small-scale agriculture

Governments can play an important role as facilitators of adoption of digital automation technologies by small-scale producers by creating a level playing field for all.

- **Promote transparent data sharing and privacy standards.** By doing so, governments can enable win-win situations between service providers and small-scale producers, whereby the former use data collected by the latter in exchange of advisory services.
- **Develop an agricultural automation agenda that targets rural youth.** Small-scale producers often lack the skills – namely digital – needed to operate the new technologies and perform the new highly skilled jobs. Young farmers are a strategic target as they are often the first to adopt them, in part due to their better access to information and to digital technologies, such as smartphones. A dedicated agenda that targets rural youth and ensures they acquire the necessary skills can thus be key driver of adoption.
- **Encouraging the creation of service providers with the necessary skills.** Sophisticated technologies such as drones and robots are more expensive and entail technical challenges regarding their effective use in the field, such as recharging batteries and managing drift to non-target areas. Overcoming these issues requires pooling resources and developing technical capacities, which are best done – at least initially – by service providers rather than individual small-scale producers.

