



# Inclusively Advancing Agri-Food Systems through AI and Automation



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# EXECUTIVE SUMMARY

## AI and automation innovation will be the most significant contributor to the transformation of agri-food systems in low and middle income countries

**AI and automation solutions are transforming agri-food production and trade by completing complex physical tasks and decision-making functions usually carried out by humans.** Automation is the use of technology to complete routine tasks with minimal human intervention. AI is transforming what is possible through automation by not only automating more complex physical tasks, but also functions usually associated with human intelligence. These tasks include recognizing patterns in information, operating machinery autonomously, and communicating naturally and responsively, among others. While these capabilities are still far from general human intelligence, they have advanced rapidly and can perform a variety of narrow tasks far more efficiently than humans.

**OpenAI's ChatGPT application exemplifies the rapid pace of advancement in AI capabilities in the last year alone.** ChatGPT is an AI chatbot developed by OpenAI. It leverages OpenAI's generative pre-trained transformer (GPT) family of large language models and has been fine-tuned using both supervised and reinforcement learning techniques.<sup>1</sup> The application is estimated to have reached over 100 millions users just two months after launch, making it the fastest growing software application of all time.<sup>2</sup>

ChatGPT has received so much attention because of its ability to perform a vast array of tasks with high accuracy, ability to rapidly synthesize information into a concise, consumable form, its rapid and widespread adoption, and its exceptional design that allows for seamless interaction with people. OpenAI released the GPT-4 model only 3 years after its predecessor was released. This iteration represents another step change in AI, adding multi-modal (text, image and video) input capabilities, more factual responses, reduced hallucinations (making things up confidently) and greater alignment (i.e. guardrails to refuse to answer inappropriate or dangerous questions). However, GPT-4 does not solve these issues entirely, and it continues to reflect a disproportionately anglophone internet.

The ChatGPT algorithm is already being leveraged across a range of new applications, including apps like Spotify, Bing and Microsoft Teams and in several industries. In agri-food systems, there is great potential for it to be used for personalized digital advisory services and many other solutions, particularly if the application expands its capabilities to include languages local to small scale producers (SSPs) in low and middle income countries (LMICs).

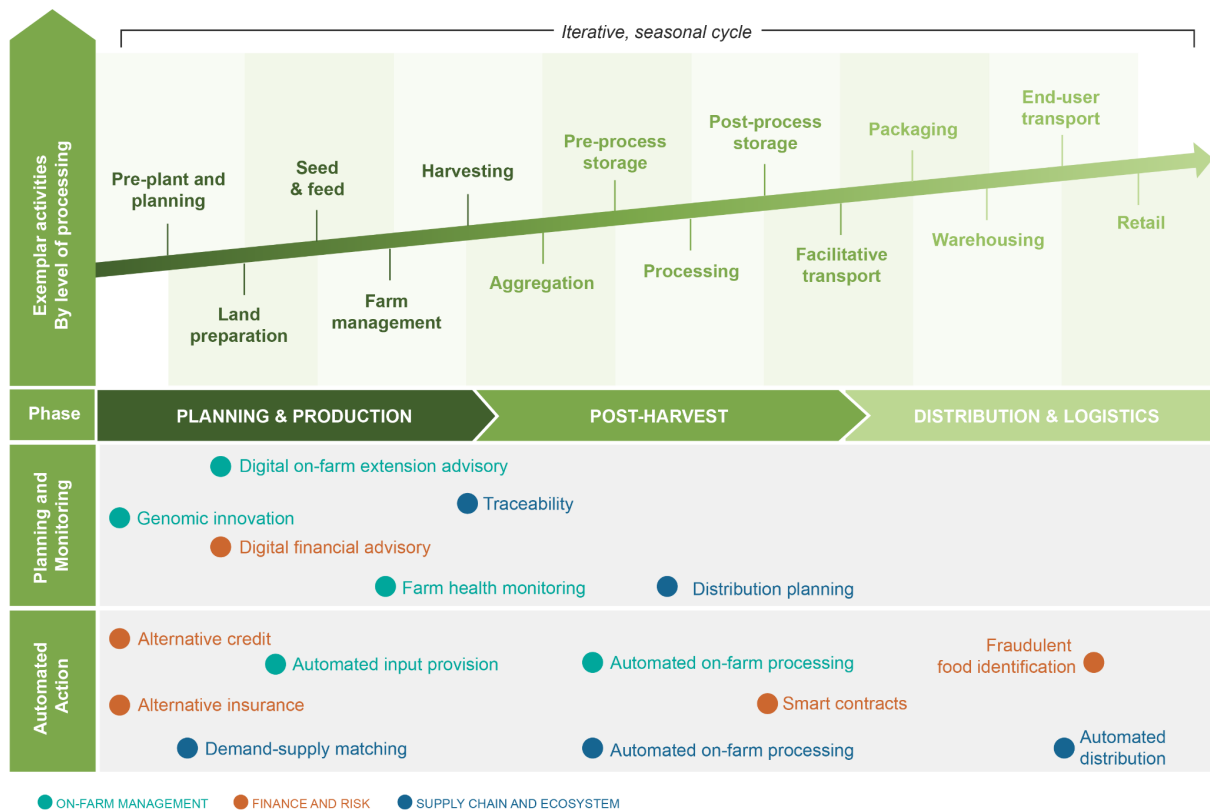
**AI and automation technologies are already being applied across agri-food value chains in LMICs, with uptake from SSPs in several cases.** This study identified a broad range of use cases where AI and automation solutions are being deployed across agri-food value chains in LMICs. While this adoption is skewed towards large and more commercially oriented producers, there are many solutions where frontier technologies are applied on the back-end and delivered to SSPs using a combination of low-tech delivery channels, in-person intermediary networks and partnerships with value chain stakeholders willing to subsidize the cost of the solution. The identified use cases cover both automated planning & monitoring and automated actions across three functions:

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<sup>1</sup> For more information on AI capabilities see Box 2; for more information on large language models see Box 3; for more information on AI learning techniques see Appendix 4.

<sup>2</sup> Reuters, 2023. Available [here](#).

- Improvements in input planning, planting, harvesting and weather forecasting are facilitated by **on-farm management** solutions, such as automated input provision and digital extension advisory.
- **Finance and risk** management solutions expand the access that stakeholders like SSPs have to financial products and services like insurance and credit.
- AI and automation solutions for **supply chain and ecosystem** management facilitate seamless value chain linkages. For example, traceability solutions and demand-supply matching.



Source: Genesis Analytics, 2023

While AI and automation solution providers are highly concentrated in a handful of LMICs, improvements in the underlying technology requirements and delivery models hold promise for supporting more widespread adoptions among SSPs. Of the countries covered in this study, the majority of AI and automation solution providers operate in India, Kenya and Nigeria. While these providers do export their solutions to other LMICs, there is a large disparity in the availability of locally relevant solutions between LMICs. Even in the prominent AgTech hubs, SSPs in a low connectivity environment with low trust in technology and low ability to pay are far less likely to adopt AI and automation solutions compared to larger-scale commercial producers. Improvements in the cost and availability of the data, infrastructure and intelligence technologies required to deploy AI and automation solutions are reducing barriers to entry and stimulating innovation by AgTech developers. Innovative delivery models for these solutions are helping to address the trust, affordability and technology access barriers that prevent SSP adoption.



## AI and automation solutions hold significant potential for SSPs and agri-food systems, but realizing this potential is not automatic

**This study has identified myriad potential benefits of AI and automation solutions in agri-food systems, with the largest being significant enhancements in agricultural productivity and outputs.**

Data collected from sensors, satellites, or drones can help SSPs prepare and use their available land optimally. Data-generated insights can identify which farm areas are most suited to which crops, and automated input provision like automated irrigation systems can optimize resource use. AI and automation solutions can also improve extension advisory services, resulting in better, more contextualized and real-time advice for farmers, improving yields. Other solutions can predict, identify and mitigate against pests and diseases to reduce spoilage. Enhancing the improved productivity of SSPs is critical for global food security, and the economic and social empowerment of SSPs and the communities in which they live.

### Indicative examples of AI and automation driving impact

<i>Solution</i>	<i>Description</i>	<i>Impact</i>
<b>eFishery</b> On-farm management	eFishery deploys in-pond sensors, artificial intelligence and automated feeders to distribute the optimal amount of feed within the pond, based on pond, fish and shrimp condition.	20% increase in profit amongst fish farmers. <sup>3</sup>
<b>Apollo Agriculture</b> Finance & risk	Apollo Agriculture is a tech start-up collecting satellite imagery of farms. The company uses predictive AI to analyze this data, to establish credit profiles for small-scale producers that would otherwise be excluded from accessing finance. The firm bundles finance with inputs, advice, insurance and market access.	2.0 - 2.5x increase in crop yields. <sup>4</sup>
<b>Hello Tractor</b> Supply chain & ecosystem	HelloTractor is a digital platform that connects tractor owners with farmers requiring tractors. Tractors are fitted with low-cost IOT devices which collect data about the farm and the tractor. This data is analyzed using AI, to provide intelligent predictions on, for example, when tractor maintenance is required or likely crop yields.	>70% of farmer users report that increased quality of life, crop revenue and crop production <sup>5</sup>

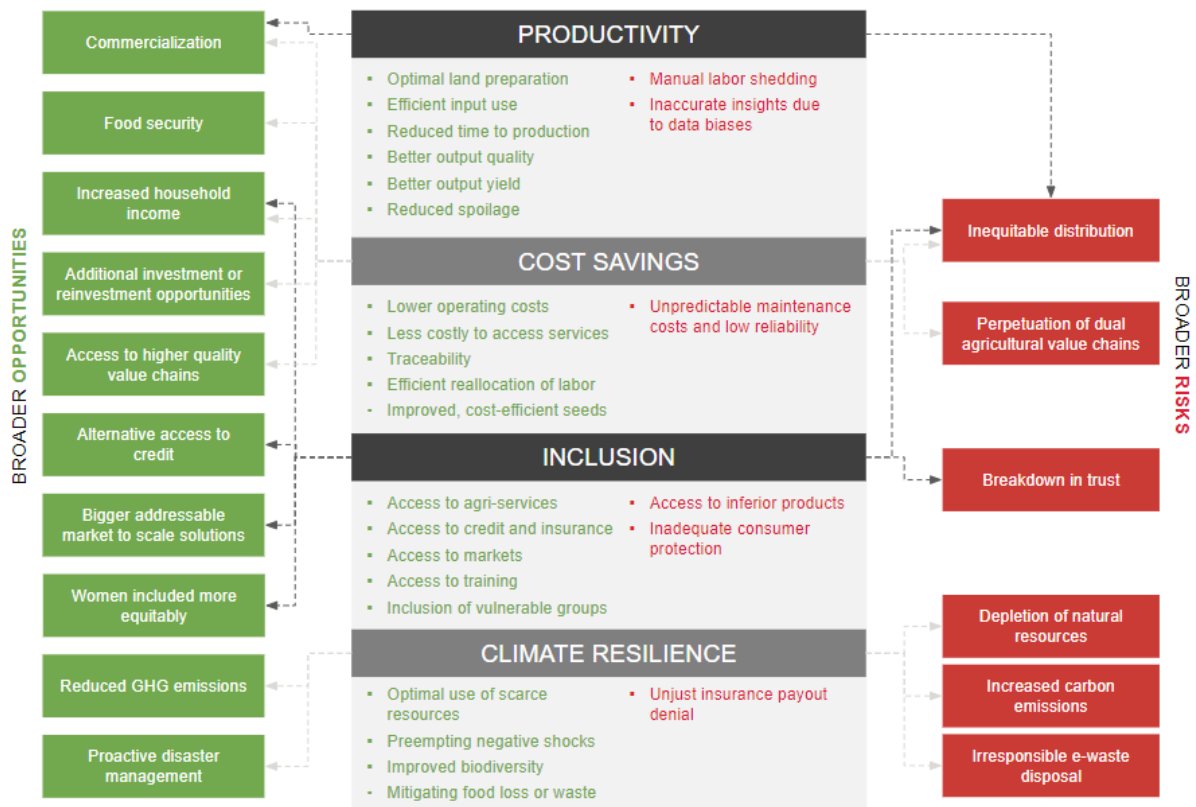
**AI and automation solutions can also generate significant cost efficiencies, expand access to critical economic infrastructure and build climate resilience for producers.** Precision farming uses inputs more effectively, reducing costs and environmental wastage. Automation-enhanced asset sharing and aggregation means that farms can pay less to access critical inputs and hardware. Traceability solutions drive down the costs of certification (including “green” certification) and increase market access. Automated data collection and AI-enabled risk predictors can enable access to critical financial infrastructure like credit and insurance, which in turn help agricultural producers prepare for economic or climate shocks.

<sup>3</sup> GSMA, 2018. eFishery: Shaping the future of Indonesia’s aquaculture industry. Available [here](#)

<sup>4</sup> Apollo Agriculture, 2019. Increasing Food Security in Africa. Available [here](#).

<sup>5</sup> MercyCorps AgriFin, 2020. Breaking New Ground. Available [here](#).

## AGRICULTURAL OPPORTUNITIES AND RISKS











Source: Genesis Analytics, 2023

However, a major risk is that these benefits will be distributed unevenly with consequences for competition, access to economic opportunity and ethics. While this study identified several examples of AI and automation solutions promoting inclusion (e.g. alternative credit scoring promoting access to finance among female SSPs), there are also negative economic, social and ethical consequences where solutions are not adopted widely. Where benefits are disproportionately accrued by groups that are already relatively advantaged, there will be consequences for food security, local employment and economic development in rural communities. For example, if larger tech-enabled producers enjoy rapid upticks in productivity that provide them with an unmatched competitive advantage over SSPs, this may threaten rural livelihoods. Similarly, if men are disproportionate adopters of these technologies, this can further unbalance household power and income earning dynamics. Even where adoption is more equitable, there are valid concerns regarding data governance and the ethics of AI applications among SSPs.

## To inclusively advance agri-food systems, AI and automation innovation must be steered towards more inclusive outcomes

AI and automation solutions are already transforming agri-food systems. Interventions are required in four areas to drive this transformation toward more inclusive outcomes. These interventions were identified through a process of joint solutioning where stakeholders from across the agri-food and technology ecosystem identified the key constraints and required solutions for AI and automation innovation to support more inclusive outcomes.



Objectives and actions	Constraints addressed	Stakeholders responsible
<b>OBJECTIVE 1: ROBUST TECHNOLOGY AND DATA INFRASTRUCTURE</b>		
<i>Establish an agricultural data exchange with a sustainable contributor network and a reference framework for data interoperability.</i>		Donors, governments, AgTechs, NGOs, academia
<i>Reduce on-farm hardware costs by reducing import tariffs, promoting domestic hardware recycling, and stimulating open-innovation between hardware patent holders and local innovators.</i>		Governments, AgTechs
<i>Support white label software infrastructure developers to align development with the demands of AgTech developers.</i>		Infrastructure developers, AgTechs, research/consulting services, PE/VC investors
<i>Invest in the development of inclusive and frontier agricultural AI through research and representative data collection.</i>		Donors, governments, academia, AgTechs
<b>OBJECTIVE 2: FARMER-CENTRIC, SCALABLE AND FINANCIALLY VIABLE SOLUTIONS</b>		
<i>Scale the establishment of trusted intermediary networks as last-mile agents, data collectors and support staff for AgTechs.</i>		Donors, governments, AgTechs
<i>Unlock government demand for climate-smart digital extension advisory through technical assistance.</i>		Donors, governments, professional services
<i>Capacitate farmer organizations to facilitate bottom-up development of farm data management solutions, and act as procuring entities for purchasing costly AgTech solutions.</i>		Donors, governments, farmer organizations
<b>OBJECTIVE 3: SUPPORT FOR MANAGING DIGITAL, DEMOGRAPHIC AND GREEN TRANSITIONS</b>		
<i>Provide vocational training and apprenticeships to equip young rural people - especially women - to take up new work opportunities in the AgTech value chain.</i>		Donors, governments, social enterprise



*Expand social support mechanisms and pathways to productive employment to support individuals affected by disruptions.*



Donors, governments,  
social enterprise

*Support regulators to examine the potential for harm in digital market conduct in agri-food systems.*



Donors, governments

*Socialize an environmental Extended Producer Responsibility approach amongst AgTechs to shift product end-of-life responsibility upstream.*



Donors, governments,  
AgTechs

#### **OBJECTIVE 4: ETHICAL AI AND DATA GOVERNANCE**

*Develop and disseminate a domain-specific and gender-sensitive ethical impact assessment framework for the use of AI in agriculture.*



Donors, AgTechs,  
NGOs, PE/VC investors

*Pilot farmer-centric and participatory data governance models in agriculture.*



Donors, governments,  
research/consulting  
services, NGOs

*Equip farmer co-ops, NGOs and extension officers to support SSPs with recourse in the event of opaque or otherwise unethical AI decision-making.*



Donors, governments,  
farmer organizations,  
NGOs

*Establish regional AI labs to design resources and products to improve the accuracy, representativeness, explainability and failure detection capabilities of AI models in agriculture*



Donors, governments,  
AgTechs, academia



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