LESSONS IN ADAPTATION

Digital Technology for Climate Resilience

GSMA
Mobile for Development

M4D

GSMA

The GSMA is a global organisation unifying the mobile ecosystem to discover, develop and deliver innovation foundational to positive business environments and societal change. Our vision is to unlock the full power of connectivity so that people, industry and society thrive. Representing mobile operators and organisations across the mobile ecosystem and adjacent industries, the GSMA delivers for its members across three broad pillars: Connectivity for Good, Industry Services and Solutions, and Outreach. This activity includes advancing policy, tackling today's biggest societal challenges, underpinning the technology and interoperability that make mobile work, and providing the world's largest platform to convene the mobile ecosystem at the MWC and M360 series of events.

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GSMA ClimateTech

The GSMA ClimateTech programme unlocks the power of digital technology in low- and middle-income countries to enable their transition towards a low carbon and climate resilient future. We do this with the collective support of the mobile industry, as well as public and private actors. Through our research and in-market expertise, we catalyse strong partnerships, facilitating innovative digital solutions that address key challenges. Our work spans climate mitigation, adaptation and resilience strategies across the globe.

For more information about the ClimateTech programme, visit gsma.com/climatetech

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EXECUTIVE SUMMARY

Climate change is intensifying both acute shocks and long-term stresses, with disproportionate impacts in low- and middle-income countries (LMICs); where climate risks compound existing vulnerability. Building resilience requires not only infrastructure and public services, but also delivery of timely information, finance and practical support for populations quickly, inclusively and at scale. Mobile and digital technologies play a critical role in enabling and accelerating these services, but affordability, device access, connectivity gaps and trust continue to shape who benefits.

Across two rounds of funding between 2021 to 2025, the GSMA Innovation Fund for Climate Resilience and Adaptation provided catalytic grants to 23 startups in Africa and Asia to pilot and scale mobile-enabled solutions that strengthen climate resilience. Twenty-three startups were awarded grants. Their solutions focused on a range of sectors, including agriculture, water, aquaculture and fisheries, and agroforestry and non-timber forest products (NTFPs). Digital tools used ranged from SMS, USSD and agent networks to data-driven applications, Internet of Things (IoT) enabled services, and digital traceability tools such as blockchain.

AT A GLANCE: PORTFOLIO IMPACT

The Fund supported startups to pilot, test and scale digital solutions that strengthen climate resilience in LMICs across Africa and Asia.

23 organisations funded across

14 countries

£3.6M AWARDED TO GRANTEES

16.4M people supported to adapt to climate change

66.3M people reached

£19.6M in follow-on investment raised by INNOVATION FUND GRANTEES

The Fund contributed to building climate resilience by strengthening specific capacities linked to anticipating, adapting to, and absorbing climate risks over time.

OVERVIEW OF LESSONS LEARNED

The nine lessons below distil what helped solutions take hold, what slowed progress, and what made the greatest difference in building inclusive and scalable socio-economic and environmental impact.

Designing and implementing digital climate solutions

1. Digital solution development must account for contextual uncertainty.

Digital climate solutions are more likely to succeed when they are designed for real operating conditions, including instability, disrupted supply chains, reliance on third parties and shifts in users' purchasing power. Teams must also plan for the added operational complexity that comes with integrating new and emerging technology.

2. Trust must be built before adoption can scale.

Adoption of digital solutions for climate resilience depends on trust. Services must demonstrate credibility, safety and usefulness through trusted intermediaries, demonstrations and visible validation from trusted community-based agents. The strongest models blend digital and offline pathways such as agents, SMS or USSD, with reliable fulfilment, and alignment with local institutions, language needs and everyday processes.

3. Climate tech should be designed intentionally for women and other underserved users.

Inclusive climate tech must reflect the practical constraints many women and underserved users face, including limited time, phone access, decision-making power and lower access to formal support. Delivery models should combine simple digital channels, such as SMS or USSD, with trusted field agents and practical training. Services are more effective when they also create pathways to reliable markets and affordable finance, and when sex-disaggregated data is actively used to improve design, delivery and retention.

Creating impact and building climate resilience outcomes

4. Behaviour change requires practical, repeated decision support.

Digital services are most effective at driving behaviour change when they help users make better day-to-day decisions, such as when to plant, irrigate, treat disease or sell. Advice must be specific, feasible and linked to near-term benefits. Bundling guidance with finance, insurance or services reduces friction and enables action, while sustained change requires repeated reinforcement through trusted channels.

5. Financial resilience must be strengthened through practical livelihood support.

Digital climate solutions improve financial resilience when they help users make better production decisions, secure more reliable sales and payments, and access finance and insurance more easily. Stronger financial outcomes depend not only on information, but also on dependable operations, trusted delivery and products that users can realistically act on.

6. Environmental benefits and ecosystem outcomes should be anchored in practical, measurable actions.

Digital tools can generate environmental benefits when they help users apply inputs more precisely, reduce post-harvest losses, and improve tree and forest stewardship through better tracking, training and decision support. While some environmental gains can be immediately measurable, ecosystem outcomes like regeneration and biodiversity recovery require multi-year monitoring and active environmental risk management.

7. Climate resilience is best measured through changes in resilience capacities, behaviours and decision-making, supported by operational data.

Climate resilience is most feasible to measure through intermediate capacities and practical decision changes, rather than as a single end-state within grant timelines. Measurement is strongest when user research is triangulated with operational data, such as engagement, transactions, fulfilment, and sensor or test outputs, while recognising that ecosystem outcomes require longer-term tracking.

Leveraging partnerships and ecosystem support for scale

8. Scaling climate resilience solutions depends on building operating capability as well as expanding reach.

For climate resilience startups, scale is not a single milestone but a combination of wider reach, stronger operating capability and improved commercial viability. Progress beyond pilots is often enabled by partnerships, but growth remains constrained by talent gaps, adoption costs, weak connectivity, and complex regulatory or procurement environments.

9. Ecosystem support is most effective when it helps startups overcome delivery constraints, while MNO partnerships are strongest when they are built on clear mutual value.

The GSMA's role extends beyond funding, with its convening power, profile-raising and tailored technical support helping startups strengthen partner confidence, access new relationships and improve investor readiness. MNO partnerships are strongest when startups bring a clear commercial ask and a pilot-ready solution, and when operators can help address a core delivery need such as payments, distribution, connectivity or data.

Implications for future funds and partners

Digitally enabled climate resilience delivers the strongest results when solutions are designed for disruption, delivered through trusted and well-supported adoption pathways, and measured through realistic changes in use, behaviour and outcomes over time. Future funds and partners should finance delivery and adoption as core costs, match support to different business models and routes to revenue, set realistic evidence expectations for resilience and environmental outcomes, and strengthen partnership roadmaps early, particularly where MNOs and other ecosystem actors can help remove barriers to scale.

INTRODUCTION

Climate change is intensifying both acute shocks and longer-term stresses worldwide, from extreme weather events to slow-onset changes such as heat stress, rainfall variability and rising sea-levels. Although these impacts are global, they are not evenly shared. Nearly 8 in 10 people living in poverty are directly exposed to climate hazards.[1] Low- and middle-income countries (LMICs), including many across Africa and Asia, are often disproportionately affected by climate change. This is because climate risks interact with and intensify existing vulnerabilities,[2] including poverty, insecure livelihoods, limited access to formal support, and tight public services budgets. For households and small businesses, this can mean repeated losses, difficult decisions about spending, saving and investment, and slower recovery from climate-related shocks.

In this context, building climate resilience depends not only on infrastructure and public services, but also on the ability to delivery timely information, finance and support quickly, inclusively and at scale. In this report, climate resilience is understood in practical terms as the capacities that help people, communities and systems manage climate risks over time. Figure 1 summarises the working definition used by the GSMA ClimateTech programme and applied throughout this Fund and lessons learned analysis.

Figure 1: How we define climate resilience

Climate action

The GSMA ClimateTech programme has adapted the United Nations Sustainable Development Goal (SDG) definition of climate action for its own work to include:

Actions taken to reduce greenhouse gas emissions and thus mitigate climate change

Actions taken to build the resilience of the most vulnerable communities to climate change stressors and threats

Actions that drive sustainable use, management and protection of natural resources and the environment in areas most vulnerable and exposed to climate change stressors

Climate resilience

In this context, climate resilience is defined as supporting communities and vulnerable groups to:

Anticipate

Anticipate climate variability and risks from extreme climate events, thus supporting preparedness and planning (e.g. through early warning systems)

Adapt

Adapt to multiple, long-term and evolving climate change risks (e.g. through precision agriculture and long-term weather forecasting)

Absorb

Absorb adverse conditions, emergencies or disasters (e.g. through access to credit and insurance in the event of a climate disaster)

1. UNDP (2025). 2025 Global Multidimensional Poverty Index (MPI). Overlapping Hardships: Poverty and Climate Hazards.
2. IPCC (2022). Summary for Policymakers. In: *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

Challenges and opportunities in the development of digital climate resilience services

Mobile and digital technologies can play a central enabling role in strengthening climate resilience and adaptation by enabling access to the information, assets and finance needed to anticipate, cope with and adapt to climate challenges (figure 2).

However, significant **barriers to digital inclusion and effective use remain, and these extend well beyond network coverage**. In many LMICs, the larger challenge is a usage gap: even where connectivity is available, people may still be unable to benefit from digital services because of the cost of devices and data, limited digital skills, unequal control over phone access, low trust in digital systems, or services that are poorly suited to their needs and circumstances. These barriers often fall most heavily on women, young people and rural populations, while gatekeepers, shared device use and exclusionary service design can further limit access.[3] Affordability remains an important part of this picture: across LMICs, the affordability of an entry-level, internet-enabled device has remained relatively unchanged since 2021 and represents 16% of the average monthly income, rising to 48% for the poorest 20%.[4] Together, these constraints have direct implications for how climate resilience solutions are designed and delivered, including channel choice, user experience, and the need for low-cost, low-data and assisted delivery models.

MNOs and the wider mobile ecosystem are central to overcoming these constraints and taking solutions to scale. Through their networks, platforms and trusted customer relationships, MNOs can extend services into climate-exposed and underserved areas, support distribution and customer care, and provide payment rails that make services more accessible and sustainable. Their agent networks and customer insights help tailor delivery models to local contexts, reduce barriers to adoption and improve last-mile reach.[5] This role is also being reinforced through initiatives such as the GSMA Handset Affordability Coalition, which aims to accelerate access to affordable internet-enabled devices for low-income populations and help close the mobile internet usage gap.[6]

GSMA research shows that MNOs have an important role to play in delivering climate resilience services. They combine connectivity, platforms and customer reach to disseminate alerts, enable service access and support continuity during climate-related disruptions.[7] At the same time, the sector's dependence on reliable energy supply means that energy access gaps and power instability can directly affect network performance, and the continuity and costs of digital service delivery, particularly in areas most exposed to climate risk. Recent GSMA research highlights that frequent power outages, lack of grid access, high energy costs and limited access to renewable energy remain major challenges for the sector, with many MNOs and tower companies in Africa still relying on diesel generators when grid power fails.[8] This creates a dual role for the sector. It must decarbonise and strengthen its own operations, while also being well positioned to support climate resilience through connectivity, platforms and partnerships.[9]

The market for climate tech is evolving rapidly, yet the pathway from early innovation to sustainable scale remains particularly difficult for startups serving vulnerable communities. Many companies operating in adaptation and resilience face a high burden of proof, long time horizons for impact and revenue, complex partnerships that often involve governments, humanitarian actors, or value chain intermediaries, and business models that can be difficult to validate. Evidence from the GSMA's wider innovation portfolio highlights a recurring pattern, where promising solutions often struggle to move from pilot to scale because early-stage risk capital is limited, operational and

3. Waller, C. (2025). Understanding the evidence in the Digital Inclusion Evidence Gap Map. GSMA.
4. Shanahan, M. & Bahia, K. (2025). The State of Mobile Connectivity 2025. GSMA.
5. Loukos, P. & Chassin, L. (2020). The GSMA AgriTech Toolkit for the Digitisation of Agricultural Value Chains. GSMA.
6. GSMA (2026). GSMA Handset Affordability Coalition. GSMA.
7. Acland, S. et al. (2026). Japan's Early Warning System: The Role of Mobile Network Operators. GSMA.
8. Kamiya, G. (2023). Energy Challenges for Mobile Networks in Sub-Saharan Africa. GSMA.
9. GSMA (2026). Climate Tech Horizons 2026.

Figure 2: Using technology for services to build climate resilience

→ Technology layer

Mobile apps
Applications on smartphones that provide users with digital access to information, services, transactions and tools for communication, planning or decision-making.

AI
Data-driven models and automated systems that help to generate insights, predictions, recommendations or process efficiencies at scale.

Big data
Large and complex datasets, including mobile, platform or sensor data, that can be analysed to identify patterns, improve targeting and support planning or service delivery.

Mobile Money
Digital payment tools that enable users to send, receive, store and manage money, and to access financial services such as payments, savings, credit or insurance.

Voice, USSD, SMS and IVR
Mobile communication channels that enable users to access information and services through basic phones, text or voice, including low-connectivity and low-literacy contexts.

IoT
Connected sensors and devices that collect and transmit real-time data on environmental conditions, assets, infrastructure or user activity.

Blockchain
Distributed digital record systems that can support traceability, verification and more transparent transactions across supply chains and service delivery systems.

GIS and satellite imagery
Geospatial tools and earth observation data that support mapping, monitoring and analysis of environmental conditions, land use, weather patterns and climate-related risks.

CLIMATE RESILIENCE

→ Service layer

Climate information and risk communication
Help to understand changing conditions, anticipate risks and plan ahead.

Advisory, optimisation and decision support
Help to make better climate-related decisions and improve the efficiency of production, resource use or operations.

Access to finance, markets and essential services
Help to secure finance, inputs, buyers, payments, insurance or other services needed to manage risk and sustain livelihoods.

System and service delivery optimisation and strengthening
Help organisations, governments and providers improve planning, targeting, coordination, continuity and overall delivery in climate-vulnerable settings.

Monitoring, traceability and environmental stewardship
Help to track environmental conditions, verify practices, improve accountability and support more sustainable management of land, forests, water and a value chain.

commercial viability has not yet been sufficiently demonstrated, and the strategic partnerships needed to support broader deployment are not yet in place.[10] These challenges are often more acute in underexplored sectors, where market signals are weaker, customer segments are harder to reach, and the evidence base is thinner. In such contexts, catalytic partnerships can help bridge the gap to scale by strengthening the value proposition, building investor confidence, expanding access to strategic networks and supporting wider deployment.[11]

Wider sector analysis highlights a persistent mismatch between the scale of climate finance and what reaches locally led adaptation and resilience efforts. Adaptation accounts for just five per cent of total climate finance,[12] and only a limited portion of adaptation funding is directed towards building local resilience or specifically focused on local communities.[13] This shortfall can constrain the very initiatives that are most attuned to local risks and best positioned to deliver practical, sustained adaptation outcomes. Against this backdrop, the GSMA Innovation Fund plays an important bridging role by providing early-stage, risk-tolerant support to local innovators whose solutions may otherwise struggle to secure climate finance, build an operational evidence base, and attract the partnerships needed for scale.

Additionally, large funding mechanisms can be slow and poorly aligned with the timelines and evidence needs of innovators, meaning many high-potential solutions struggle to bridge the gap between early pilots and scalable delivery.[14] By helping startups test and strengthen their models at an earlier stage, the Fund can support the transition from promising innovation to scalable implementation. **Recent investment tracking suggests adaptation and resilience, in particular nature-based solutions, are rising on investor agendas** for climate tech, even as mitigation or mitigation solutions which integrate resilience building continue to dominate overall.[15]

10. Li, B. & Hinrichsen, S. (2023) Scaling Digital Innovation in Emerging Economies - The impact of GSMA grant funding on start-ups in low- and middle-income countries. GSMA.
11. Chassin, L. (2024). Investment readiness: A toolkit for agritech innovators. GSMA.
12. Wignarajah, D. et al. (2023). State and Trends in Climate Adaptation Finance 2023. CPI-GCA.
13. Watkiss, P. (2023). Adaptation Finance Gap Update 2023: Underfinanced. Underprepared. Inadequate investment and planning on climate adaptation leaves world exposed. UNEP.
14. The Earthshot Prize (2025). Unlocking Critical Finance for Climate & Economic Resilience.
15. Cox, E. et al. (2024). State of Climate Tech 2024: Seeking an edge as deal-making slows. PwC.


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PORTFOLIO OVERVIEW

The GSMA Innovation Fund for Climate Resilience and Adaptation was launched at COP26 in November 2021 to support startups, small and medium enterprises (SMEs) and social enterprises leveraging mobile and digital technology to build the climate resilience of vulnerable low-income communities and marginalised groups in Africa and Asia. With support from FCDO and Sida, the first round awarded 12 startups equity-free grants of between £100,000 and £250,000 to pilot and scale their innovations over a period of 18 months. In addition to grant funding, startups received benefits such as GSMA-facilitated industry partnerships, mobile and digital technical assistance, monitoring and evaluation and market expertise from GSMA staff, and a platform to raise the profile of their organisations with potential investors and partners.

A second round, the GSMA Innovation Fund for Climate Resilience and Adaptation 2.0, was launched in November 2022 following COP27, awarded to 11 additional startups across Africa and Asia. This round placed a particular emphasis on solutions and sectors that are often underfunded or less visible within mainstream climate tech pathways. These included mobile and digital solutions to improve climate resilience and adaptation in coastal areas, nature-based approaches such as regenerative agriculture, sustainable forestry and biodiversity strengthening enabled by digital tools, and innovations focused on sustainable consumption and production, such as reducing food loss and waste or improving the sustainability and biodiversity of aquaculture and fisheries.

Across both rounds, the portfolio reflects a diverse set of approaches to resilience and adaptation, spanning different geographies, climate risks, customer segments and delivery models. While venture contexts vary, many share common questions central to scaling in low- and middle-income markets. These include how to reach and retain users with limited time and ability to pay, how to build trust and demonstrate value in high-risk environments, how to partner effectively with mobile operators, public agencies and value chain actors, and how to produce evidence that is decision-useful for follow-on funders, commercial partners and policymakers. Across the portfolio, these questions often surfaced in relation to access to risk capital and follow-on investment, the need for credible operational and outcomes evidence, and the role of partnerships, particularly with mobile operators, in reaching users and sustaining delivery.

This report synthesises portfolio-level lessons from both rounds of the GSMA Innovation Fund for Climate Resilience and Adaptation. It is intended for innovators and entrepreneurs, MNOs and ecosystem partners, donors and investors, and public sector stakeholders seeking to support digitally-enabled climate resilience and adaptation at scale in low- and middle-income contexts. These portfolio lessons build on and extend the GSMA's wider evidence on scaling digital innovation in low- and middle-income markets and draw on wider sector insights from climate tech and digital development experience in similar contexts.[16] The findings also complement learning from the GSMA AgriTech Accelerator, which underlines rural usage gaps and the value of iterative, user-centred design to support adoption and sustained engagement.[17]

Impact of the GSMA Innovation Fund for Climate Resilience and Adaptation

Across two rounds, the Fund supported startups to pilot, test and scale digital solutions that contribute to building climate resilience and adaptation in communities across LMICs in Africa and Asia. The Fund represents a catalytic step towards greater resilience, strengthening specific capacities linked to planning and preparedness, adapting practices and livelihoods, absorbing risks, and enabling conditions for service users, rather than implying climate resilience as a complete or final outcome.

16. Li, B. & Hinrichsen, S. (2023) Scaling Digital Innovation in Emerging Economies - The impact of GSMA grant funding on start-ups in low- and middle-income countries. GSMA.
17. Doshi, B. & Chassin, L. (2025). Agritech Accelerator - Lessons From Scaling Digital Agriculture Services. GSMA.

AT A GLANCE: PORTFOLIO IMPACT

Portfolio reach and support

23 organisations funded across

14 countries

16.4M people supported to adapt to climate change

66.3M people reached

£3.6M awarded to grantees

£19.6M in follow-on investment raised by Innovation Fund grantees

Reported outcomes among surveyed users who used relevant service features (by average)

increase in anticipatory capacity

increase in adaptive capacity

increase in absorptive capacity

These outcome figures reflect aggregated self-reported changes from user research and apply to respondents who reported using the relevant feature or service component.[18]

18. GSMA used a mixed-methods approach to gather feedback from grantee service users. Sample sizes varied across studies, and where quantitative data collection was not feasible, findings were based on in-depth qualitative interviews only.

Analytical framework / methodology

The report draws on cross-portfolio monitoring and learning activities conducted throughout implementation and at grant close, including structured grantee reporting, engagement with grantees and partners, and review of delivery experiences across both cohorts. Across the two rounds, the GSMA captured evidence and reflections to understand what enabled the design, adoption and sustainability of digital climate resilience solutions, which barriers most often slowed progress, and what early evidence suggests about their contribution to intended socio-economic and environmental outcomes linked to resilience and adaptation.

Given variation in services, delivery models and data collection approaches, impact figures should be interpreted with the following definitions and considerations in mind.

Definitions of key metrics

- **People supported to adapt** refers to direct users of core service features delivered through the grants. This includes engagement with primary components such as mobile applications, SMS-based advisory services, training programmes, IoT-enabled tools, and financial or credit profiling services.

- **People reached** represents an estimated wider beneficiary group, derived by grantees through extrapolation from direct users to include indirect beneficiaries (for example, members of a farmer's household benefiting from advisory services). These figures are indicative and should not be interpreted as direct user counts. Where users may benefit from multiple services, conservative adjustments are applied to reduce the risk of double counting and over-attribution, although some overlap may remain.

Evidence on user outcomes and behavioural change draws on:

- Quantitative surveys conducted via telephone or in-person with service users

- Qualitative interviews with users, implementers and partners

Survey sample sizes varied by project but typically included approximately 200 respondents for telephone surveys and around 50 respondents for in-person surveys. These correspond approximately to a 90% confidence level, with margins of error of approximately 6% for larger samples and 11% for smaller samples.

Insights are synthesised across nine learning areas aligned to the Fund's learning agenda, spanning solution development and delivery, user access and adoption, behaviour change, inclusion and equity, livelihood and financial resilience, environmental outcomes, scalability and sustainability, and the role of mobile industry partnerships and the GSMA. The lessons learned section that follows presents these findings across the portfolio, highlighting patterns and drawing out implications for future fund design, partnership models and investment pathways for digital climate resilience and adaptation.

CLIMATE START UPS

COHORT 1

The GSMA Innovation Fund for Climate Resilience and Adaptation

Liberia
Nigeria
Egypt
Tanzania
Ethiopia
Somaliland
Pakistan
Nepal
Philippines

COHORT 2

The GSMA Innovation Fund for Climate Resilience and Adaptation 2.0

Ghana
Nigeria
Kenya
Tanzania
Pakistan
India
Sri Lanka
Nepal
Thailand

SYNTHESIS OF LESSONS FROM THE INNOVATION FUND PORTFOLIO

Across two rounds of the GSMA Innovation Fund for Climate Resilience and Adaptation, GSMA captured evidence and reflections from grantees during implementation and at the close of the grant period. The aim was to identify what enabled the design, adoption and sustainability of digital climate resilience solutions in low- and middle-income contexts, which barriers most often slowed progress, and review emerging insights on their efficacy in achieving intended socio-economic and environmental outcomes linked to climate resilience.

Insights were analysed across nine areas, grouped into three thematic categories:

Designing and implementing of digital climate solutions

1. Solution development and delivery:

The design, launch and implementation of digital solutions.

2. Accessibility, adoption and engagement:

How users accessed services and what drove (or limited) uptake and ongoing use.

3. Inclusivity and social equity:

The extent to which solutions reached and benefited marginalised groups and promoted equitable outcomes.

Creating impact and building climate resilience outcomes

4. Knowledge and behaviour change:

Whether and how services influenced decisions and practices over time.

5. Livelihoods and financial resilience:

Changes in users' income security, financial stability and ability to manage risk.

6. Environmental and ecological outcomes:

Evidence of environmental benefits and how these were measured or observed.

7. Measuring climate resilience:

What aspects of resilience can be measured in practice, including the use of proxies and triangulation across data sources.

Leveraging partnerships and ecosystem support for scale

8. Scalability and sustainability:

Pathways to growth and long-term viability, including operational and commercial models, and trends in follow-on funding.

9. Role of the GSMA and MNO partners:

How partnerships and support influenced solution development, uptake and prospects for scale.

This section presents the lessons learned across two rounds of the GSMA Innovation Fund for Climate Resilience and Adaptation. It should be noted that some of the lessons learned are not unique to climate tech and reflect trends and insights from wider tech innovation in LMICs.

1. Development and integration of digital technology into solutions for climate resilience

Digital solution development in climate-vulnerable settings rarely takes places under stable operating conditions. Across the grantees, teams needed to account for uncertainty in delivery environments including disrupted supply chains, reliance on third parties, shifts in users' purchasing power, and the added operational complexity that comes with integrating new and emerging technologies. Wider context barriers such as conflict, currency fluctuations, trade restrictions and political crises quickly affect service delivery, user onboarding and product uptake. Teams therefore needed to build products and delivery models that could adapt to instability as well as to technical constraints.

Lersha tackled a difficult operating context in Ethiopia when developing and rolling out its access to finance services for smallholder farmers. Deterioration in security and limited mobility in parts of the country affected farmer onboarding and the distribution of bundled services. War in some regions made it difficult to train farmers and sell insurance for a period, while foreign currency shortages caused delays in project-related payments and increased transaction costs. This illustrates how broader political and macroeconomic instability can directly constrain implementation, even where the digital solution itself is well designed.

Data-heavy features depended on dataset quality and control, and **teams often found that third-party data sources and outsourced pipelines could not deliver the accuracy, cost or speed they had assumed**, particularly where available data was incomplete, insufficiently representative or difficult to validate in practice. This was most evident where models needed local ground truthing (e.g. disease detection, soil diagnostics, hyperlocal weather, speech recognition), and where biases and omissions in existing data sources, particularly around local languages, rural users and underrepresented groups, quickly undermined trust and slowed adoption. As a result, many teams shifted towards greater data control by collecting core datasets directly, validating remote or partner data through field checks, and iterating in shorter cycles using real user inputs, even when this meant trading speed for reliability.

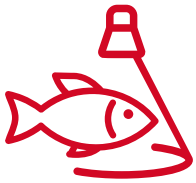
BKK explored automatic speech recognition (ASR) to scale its farmer advisory and IVR services, aiming to make voice support faster, cheaper, accessible and inclusive for rural users. In practice, ASR performance was constrained by the data burden needed to reach usable accuracy in Pakistan's highly diverse linguistic landscape, with more than 77 local languages and dialects. The team found that even where the concept worked in limited tests, accuracy did not reach a reliable level for real advisory delivery at scale, so they paused further ASR rollout and reverted to the call centre as the dependable channel. In multilingual markets, voice automation is not plug-and-play. Teams need to invest early in large and representative voice samples, dialect coverage, and rigorous dataset preparation (and ongoing retraining), and to plan for a hybrid model where human support remains essential until accuracy and user trust are consistently high.

HydroNeo deployed shrimp disease radar for farmers in Thailand, but the quality and quantity of external datasets did not meet the startup's needs and outsourced classification was not dependable, so the team shifted to collecting images directly from farms through phone uploads. They drew on support from an academic research partner to improve classification, trading speed for greater control over data quality and relevance.

Disruptive and emerging technologies often required more operational maturity than teams initially anticipated, reflecting a wider innovation pattern which is not unique to climate tech. Moving from a successful pilot to a dependable service required operational discipline, including training, QA, support, monitoring and clear workflows, as well as sustained capacity building and adaptation to existing delivery processes.[19,20,21] This was especially true for blockchain, IoT and AI, where delivery teams needed to ensure that data, models, devices and integrations performed reliably in real conditions through ongoing monitoring and iteration.

Dayaxa Frankincense (DFEC) initially used complex blockchain software for frankincense traceability in Somaliland. The team scaled back functionality to stabilise performance and introduced in-house training on data uploads to keep processes consistent.

Externally, regulatory and political dynamics, alongside market competition and timing constraints, often shaped whether products could be deployed.



Simusolar developed Bluetooth-enabled IoT solar fishing lights (Nuru) for fishers on Lake Victoria, Tanzania to replace kerosene lamps and improve safety, productivity, tracking and overfishing. During implementation, the project was affected by shifting testing requirements and restrictions, even after initially aligning with Ministry of Livestock and Fisheries guidelines. At the same time, pricing pressures and a seasonal ban on fishing lights constrained market reach. Simusolar responded by generating quantitative evidence of Nuru's effectiveness, educating fishers on the economic benefits, and iterating the design to improve affordability and usability. Despite early sales, the experience showed that regulatory volatility and market constraints can ultimately make continued operation unviable, and Simusolar has since discontinued the solar light in part due to the operating environment.

Simusolar's experience was the most visible example of a broader pattern observed across the portfolio, in which regulatory and governance factors played a more significant role in shaping implementation than had generally been anticipated. Two dynamics stood out. First, the telecom ecosystem presented unexpected complexity, with MNO commercial frameworks and internal policies sometimes creating friction that early-stage startups were not well placed to navigate. Second, government product regulation occasionally proved unpredictable, with licensing requirements, standards enforcement, and shifts in political context capable of disrupting otherwise well-designed projects. Both patterns suggest the regulatory environment merits more explicit consideration in future fund design.

19. White, L. & Arathoon, L. (2025). Blockchain in Agriculture: Global Lessons and the Kenyan Experience. GSMA.

20. Humeau, E. & Deshpande, T. (2024). AI for Africa: Use cases delivering impact. GSMA.

21. McFadden et al. (2022). The Digitalisation of Agriculture: A Literature Review and Emerging Policy Issues. OECD.

2. Accessibility and adoption of digital solutions for climate resilience

Trust was identified as a key adoption constraint across the portfolio, however this is not unique to climate tech. Many of the lessons are consistent with insights from the recent GSMA AgriTech Accelerator, particularly on user-centred design and providing user support.[22] The lessons also align with the GSMA's wider research on the usage gap where barriers to mobile internet use affect user confidence when using digital services and commonly include skills and literacy gaps, safety and security concerns, affordability and connectivity quality.[23] Users' prior experience of unreliable or low-quality digital services further dampened adoption and increased the need for reassurance, including clear explanations of how the service worked and support to build confidence in its reliability and value. Users often needed time and repeated engagement before they were ready to see the service as credible, dependable and worth using consistently. This made conversion slower and more resource-intensive, while long-term value depended on whether services could build enough trust to sustain use over time. Trust grew more quickly when services showed clear, practical evidence of their value through demonstrations, field validation and trusted human support.

Agent-led and assisted models can outperform self-serve digital journeys in low-trust and low-literacy settings by reducing perceived risk and making the value proposition tangible.[24,25] Among Fund grantees, the **strongest models therefore offered a spectrum of digital, hybrid and non-digital pathways** rather than relying on digital-first delivery alone. Trust was strengthened through demonstrations, field validation and embedding services in trusted local structures from the outset, while intermediaries such as extension systems, cooperatives, aggregators and buyer networks reduced friction by providing familiar entry points, reinforcing credibility, and linking digital guidance to reliable fulfilment pathways such as input access, logistics and payments. In this way, offline trust and support often acted as a bridge to digital participation, widening access for rural and marginalised users and supporting awareness, onboarding and sustained use.

Crop2X supported smallholder farmers in Pakistan with satellite-based crop monitoring and simple, colour-coded advisories (often shared via WhatsApp). Farmers generally valued the recommendations, but many initially struggled to interpret the reports and only acted with confidence after follow-up support from agents by phone or in person. Satellite imagery helped make field issues visible and therefore more credible, yet farmers still sought human validation before modifying practices. Trust was strengthened when services made data tangible through visual evidence, field-level explanations and ongoing relationships to reduce perceived risk.

22. Doshi, B. & Chassin, L. (2025). Agritech Accelerator - Lessons From Scaling Digital Agriculture Services. GSMA.
23. Shanahan, M. & Bahia, K. (2025). The State of Mobile Connectivity 2025. GSMA.
24. GSMA (2016). Comparing Agent-led versus Self-register subscription models for mAgri services.
25. Ding et al. (2022) The effects of combined digital and human advisory services on reducing nitrogen fertiliser use. International Journal of Agricultural Sustainability.

Crop2Cash supported smallholder farmers in Nigeria to manage drought risk by linking them to agri-insurance and drought-resistant seeds through a low-tech USSD/mobile channel, complemented by advisory content. Adoption strengthened when the service was delivered through public extension agents, whose field presence and legitimacy helped reach farmers who would not otherwise engage via mobile tools.

BKK paired its digital weather and advisory services with local agents and community leaders to support onboarding and credibility in rural Pakistan. This phygital approach was especially important for building trust where users had prior poor experience of weather advisory services, and to enable women's participation.

Farm to Feed, which links Kenyan smallholders to buyers for surplus or imperfect produce, similarly found that many farmers preferred a relationship-led journey, calling staff, relying on trusted agents and using physical aggregation and logistics, even where USSD or app options existed.

Blended delivery can also be a staged pathway, rather than a permanent split between digital and offline. The strongest models designed services so users could immediately access core value through low-tech channels and human support, while enabling a clear progression into richer smartphone features over time as device access, data affordability and digital confidence improve. This tiered approach protects inclusion in the near term but still captures the expanded capabilities of smartphones by deepening service levels for users, rather than forcing an all-or-nothing shift to app-only delivery.

GeoKrishi's e-Chautari in Nepal illustrated how blended delivery can serve as a staged pathway rather than a fixed split between digital and offline channels. By setting up internet-enabled community hubs in places such as cooperatives and local government offices, and supporting farmers through facilitators, the service enabled users with low digital literacy or limited device access to receive immediate value from advisory content, weather information and expert support. At the same time, exposure to the GeoKrishi app and its functions helped build confidence and familiarity, creating a gradual pathway into more independent use of smartphone-based services as access and capability improved.

Adoption also depended on how well solutions aligned with local structures, institutional priorities and day-to-day operating processes. Where climate tech startups could work with government or integrate into established systems, legitimacy improved and pathways to scale became clearer. Conversely, data-dependent features and partnerships often took longer where incentives were misaligned, or where reputational and privacy concerns deterred reporting and sharing.

Komunidad's early warning system and climate analytics tools initially saw limited uptake despite dashboards and marketing, but after partnering with a municipality with an active climate adaptation agenda, uptake increased significantly, boosting visibility and sustained use through public buy-in. Embedding services within community and value chain structures also reduced friction.

Disaster Risk Reduction and Management Office (DRMMO) staff using Komunidad analytics tools in the Philippines.

Aloi supported smallholder dairy farmers in Nepal to access finance by creating digital credit profiles through cooperative milk collection data. Uptake improved when the service was integrated into cooperative routines such as milk collection and record keeping, with credit profiling and repayment corresponding to existing ways of working rather than requiring a standalone digital finance journey.

Across the portfolio, usability improved when platforms accounted for local language needs, cultural familiarity and different literacy levels, including through simplified terminology, more visual or voice-led journeys, and repeated hands-on reinforcement. Acceptance of services also depended on cultural fit.

Lersha provided smallholder farmers in Ethiopia with a one-stop digital service combining climate-smart agriculture advice and weather information, alongside pathways to agri-credit and agri-insurance. In some predominantly Muslim communities, user research found that farmers were reluctant to use the credit element due to low awareness and because paying interest conflicted with Islamic principles, even though they were comfortable using insurance. Farmers suggested offering insurance as a standalone product, separate from credit, to better align with their needs and beliefs. While there was initial scepticism about the bundled offer, support from agents, partners and government stakeholders helped build interest over time.

User engagement rose most reliably when people understood the value of a service before learning how to use technology linked to that service. This was especially true where technology introduced a new category of service, such as soil testing, rather than digitising an existing practice. Sensitisation and education helped users link information to yields, income and risk, while actionable guidance that acknowledged cost constraints improved satisfaction and reduced drop off.

Bizy Tech learned that farmers who associated soil testing with physical sampling were wary of satellite-derived soil recommendations. Uptake improved when satellite insights were used to target fields and identify trends, then validated through on-site sampling and portable kits. Advisors and demonstrations made results tangible, increased confidence, and strengthened willingness to change fertiliser practices and purchase inputs.

3. Inclusivity and promoting social equity

Climate change is not gender neutral. Women and men may face many of the same shocks, but women often experience them with fewer assets, less access to formal services and institutions, and more limited access to extension, finance, information and technology, leaving them less able to adapt.[26] These inequalities are reinforced by digital exclusion, and GSMA's gender gap research highlights women are 14% less likely than men to own an internet-enabled phone and use mobile internet, therefore limiting their access to digital services.[27] Women are underrepresented among users of digital agriculture services, reflecting wider barriers to access and uptake. Closing these foundational gaps in digital access and usage is essential if digital climate, marketplace and finance services are to benefit women at scale.[28,29]

Market access can expand opportunity, but opportunity alone does not translate into uptake or investment when women cannot finance the choices the service enables. Women face structural constraints around credit and collateral, compounded by lower land ownership and unequal treatment from formal providers, which can prevent them from investing in inputs, tools or adaptation measures. Tailored pre-financing and affordable loans help smooth cashflow, unlock participation and enable productive investment, with users choosing to cover daily expenses during lean periods or invest in assets that raise productivity.

This broader pattern was reflected in our research with grantees' service users. Most people were already experiencing daily disruption to their lives and livelihoods through climate change. **Men and women described similar exposure to shocks, but women commonly reported receiving less institutional support** to cope with and adapt to these impacts.[30] In contrast, men more often described having access to at least some external assistance.

26. Chitiga-Mabugu, M. et al. (2023). Climate Change and Women – Impacts and Adaptation. International Review of Environmental and Resource Economics.
27. Jeffrie, N. (2025). The Mobile Gender Gap Report 2025. GSMA.
28. Gamble, E. & Chassin, L. (2023). Improving Farmer Livelihoods Through Digitised Agricultural Value Chains - Results and lessons from the GSMA Innovation Fund. GSMA.
29. World Bank (2023). Closing Gender Gaps In Digital Development. A Practical Guide for Operational Teams.
30. Institutional support in this context includes extension advice and trainings, links to cooperatives or programmes, or other formal sources of assistance such as input support, finance, insurance or post-shock relief where available

This gap is partly structural. In many settings, formal support is channelled through household heads, landholders or recognised farmers, and through institutions where men are more visible. As a result, women are less likely to be registered, informed or considered eligible, even when they are responsible for a large share of agricultural and household work. **This disparity is especially significant because women frequently assume a heavier household burden**, including safeguarding food security, managing care responsibilities and absorbing income shortfalls when earnings decrease.

Digital climate services are most likely to be transformational for women when they are built to work with, and help strengthen, the wider ecosystem of support. In practice, that means startups and innovators designing for existing constraints before onboarding. Time and autonomy often determine whether women can engage at all, so services need accessible channels and trusted human support, alongside pathways to finance, markets and local legitimacy. Otherwise, even strong information products risk excluding the users they aim to serve, because women face higher barriers to becoming active users of climate tech services.

Building on this, effective delivery models for women depended not just on access, but on using different channels in ways that reflected women's realities. Across the cohort, in-person workshops, structured training and field agents repeatedly helped to raise awareness, build skills and strengthen confidence to both try and keep using climate tech services. Low-tech channels such as SMS and USSD often fit more naturally with women's access and daily routines, while app uptake was constrained by smartphone access and, in some settings, by whether women could use a device independently. Experience also shows that gender-responsive delivery works best when it accounts for local cultural norms and household dynamics, rather than assuming individual uptake. In some settings, women-only engagement strategies were not always the most effective route.

Crop2X delivered satellite-informed crop monitoring and advisories to smallholder farmers in Pakistan. The team noted that women's participation was stronger when engagement activities also included male household decision-makers, helping to build understanding and support for women to take part. This insight was based on implementation experience rather than quantified outcome data.

CoAmana piloted nine solar irrigation pumps on a lease-to-own model for women farmers in Nigeria. Women sub-leased the pumps to around seven other farmers each week to offset repayments, and the pilot was well received. However, restricting access to women also prompted some men to request inclusion, highlighting the need for clear communication and community engagement alongside targeting.

When women gain direct access to dependable buyers, the evidence suggests a step change in both economic security and confidence. Marketplace features that purchase produce directly from farmers were among the strongest drivers of positive outcomes for women service users across the portfolio as they replace uncertain, often exploitative trading relationships with fairer and more reliable prices that reduce stress and strengthen resilience. This has considerable value where middlemen dominate or where crops are perishable, because women can capture more value for their time and labour instead of losing produce or being forced into distress sales at the end of the day. But these gains are only realised if women can reach and use the service.

Vitara supported women shea farmers in Ghana, many of whom depended on irregular traders and intermediaries offering low prices and little bargaining power. This often forced them into distress sales after long journeys to market. By providing a reliable buyer and fairer prices, Vitara created a more secure route to market. Women reported higher earnings, less stress about selling their produce, and greater confidence and respect as a result.

Gender-sensitive approaches must be embedded from design through to delivery if they are to improve inclusion. Grantees made practical adjustments to reach women through training, field agents and community engagement, but these insights were not always carried through into the digital service itself. Many teams focused on making products simple for everyone, but this can still align more closely with men's circumstances where women have less time, less phone access, or less freedom to use devices independently. Sex-disaggregated data was usually collected for reporting, but it was not always used to shape improvements. GSMA capacity building helped bridge this gap, prompting grantees to strengthen gender strategies and use sex-disaggregated data for business insight and decision-making. Where teams used gender data to inform decisions, the route to wider inclusion and stronger retention became clearer.

Monsoon Tea used a gender needs assessment to identify gender-based violence as a key barrier for women tea farmers in northern Thailand. This informed a tailored delivery approach, including women-only trainings that created a safe space for discussion and support. In turn, women reported feeling more included and better able to engage with the service, showing how gender-sensitive design can carry through into implementation and strengthen inclusion in practice.

4. Leveraging digital technology to accelerate behaviour change for climate resilience

Digital solutions were most effective in stimulating behaviour change when they helped users anticipate climate shocks, adapt over time, and cope with difficult climate conditions. Across the cohort, the clearest behaviour-change pathways were those that matched the Fund's definition of climate resilience, although users themselves described the benefits in more practical terms, such as protecting yields or catch, avoiding losses, saving time or securing income. Viewed through this lens, these changes reflect improved preparedness, stronger resource management and reduced exposure to climate-related stress.

Behaviour change was typically preceded by increased knowledge and confidence, whether related to weather risk, soil and water management, disease prevention, safer operations, market timing, or eligibility and compliance in value chains. However, while many users appeared more aware of climate risks and more open to changing their practices, this did not always translate into action where the recommended response was unaffordable, unavailable in local markets, or difficult to implement within existing livelihood constraints. This reflects broader behaviour change theory: people do not change behaviour simply because they know what to do; change is more likely when knowledge is accompanied by the capability, opportunity, and incentives to transfer knowledge into action.[31] This was more achievable where services were built on users' existing knowledge and decision-making habits through a user-centred design process. In practice, this often required more than a single training or advisory interaction. Behaviour change was more likely where messages were reinforced through multiple touchpoints, including, in some cases, similar information users had already received from other sources.

GeoKrishi delivered digital agricultural advisory to smallholder farmers in Nepal. The service helped farmers build knowledge of climate-resilient practices and supported them to act, with many reporting adoption of recommended practices. The guidance reinforced advice farmers had already heard before, helping translate familiar messages into follow-through. Users were more likely to implement changes when guidance was specific, feasible and clearly linked to near-term benefits. Where recommendations implied costs or more complex shifts, uptake was stronger when services provided prioritised actions, staged plans, or some form of risk cushioning, enabling users to act within financial constraints.

31. Michie, S. et al. (2011). The behaviour change wheel: a new method for characterising and designing behaviour change interventions. Implementation Science.

Convenience was also an important enabler of action. Bundled solutions made the resilient option the easiest by offering a genuine one-stop shop, bringing together services people value and use in everyday decision-making within a single, joined-up offer. By reducing steps, difficulty and uncertainty, and combining resilience support such as guidance or insurance with finance and other practical services, these models encouraged more frequent engagement and helped users take timely, incremental actions over time. This mattered because behaviour change rarely follows from a single intervention: while one-off training or a single message may raise awareness, sustained change was more likely where users received repeated prompts, reinforcement through trusted channels, and decision support at the moment choices were made. This aligns with wider evidence that reducing friction can materially improve uptake. For example, a Busara study in Kenya found that simplified processes increased registration for seed insurance, suggesting that users are more likely to act when services make the desired response easier and more straightforward.[32]

Lersha supported smallholder farmers in Ethiopia through a bundled digital service that combined climate-smart agriculture guidance and weather information with crop insurance and access to microcredit. This reduced friction for farmers and made it easier to take small, well-timed decisions that accumulate into longer term resilience.

This need for repeated prompts and reinforcements has implications for measurement, as it is difficult to attribute behaviour change to any single activity, and short grant timeframes can miss the gradual, cumulative effects of repeated engagement. Monitoring therefore needs to track exposure and engagement over time, alongside intermediate indicators (such as uptake, repeat use and self-reported changes in decisions), rather than relying solely on immediate post-training outcomes. Through our primary research with Fund grantees and service users, we have consolidated evidence of behaviour change that is encouraging but uneven, and there are clear limitations in how far we have been able to identify consistent instances or patterns of change. Much of the evidence relies on self-reported change, which can be affected by recall bias and differing interpretations of improvement. Attribution is also challenging when outcomes depend on intermediaries, market dynamics or existing regulations.

32. Busara (2025). Toolkit for digital service providers. Using behavioural design and human centred design to drive adoption among smallholder farmers.

5. Improving livelihoods and building financial resilience

The clearest livelihood outcome across the two Fund rounds was improved income stability. Digital services supported financial resilience through three main routes.

Firstly, **mobile and digital tools that helped people make better day-to-day decisions reduced avoidable costs and protected production**. When advice was timely and specific, users could adjust inputs, irrigation and farm practices in ways that improved efficiency and helped maintain yields in difficult seasons. However, these gains were not universal, and impact was often reported by users and difficult for the GSMA to independently verify. It should also be noted that there was evidence of users not always being able to act on recommendations, for example in the case of agricultural advisory services if agri-inputs were too expensive or not available locally.

Cashflow can improve where digital platforms make the selling process more predictable. Several startups supported this by providing clearer signals of demand, arranging collection, helping limit losses after harvest and paying on time. This gave users more confidence to plan, budget and avoid accepting low prices in a hurry. However, these gains relied on consistent operations. If pick-ups were delayed or grading was unpredictable, spoilage and income losses quickly reappeared.

J-Palm digitised traceability and sourcing in Liberia's wild palm oil value chain to improve market access and payment reliability for local harvesters. This model was linked to stronger income security for harvesters. In our study with J-Palm's service users, 100% reported selling more and avoiding unsold stock, while 95% reported faster payments for their products. Although 78% of harvesters said they would like to be paid through mobile money, usage was still low. Barriers to integrating mobile money included limited phone access in the harvesting communities and concerns about mobile money fees reducing income.

Vitara improved women's incomes by linking shea producers to stable buyers and fast payments, supported by clearer weighing and records. A pre-financing option helped to level income between harvests. Higher earnings were reported by 86% of farmers, who valued the ability to repay using harvest proceeds and reduce pressure during lean periods.

Lastly, financial resilience improved where services made finance more accessible and de-risked for users. This included using alternative ways to assess creditworthiness where people lacked formal collateral or credit histories, designing repayment models around sales or seasonal income, and bundling insurance with credit so that climate shocks were less likely to trigger default or asset depletion. By reducing lenders' exposure to weather-related losses and giving users a clearer safety net, these models could improve access to finance while helping households cope with shocks and manage seasonal gaps. As wider evidence shows, integrating insurance with finance can expand access to credit by reducing risk for both users and providers.[33] However, uptake still relied on trust and understanding. In some places, limited phone access, low use of mobile money and concern about transaction fees reduced the benefits of digital payments and slowed adoption.

Lersha improved farmers' ability to cope with shocks by helping them access crop insurance, offered alongside finance. Farmers were enrolled through an agent network and the programme reached a large number of farmers across a variety of crops. This type of cover can protect households when weather or pests reduce harvests.

33. ISF Advisors (2026). Agricultural Insurance Deep Dive. UNDP.

6. Environmental and ecological impact

The pattern of environmental outcomes observed across the portfolio reflects the thematic focus of the Fund and the sectoral mix of grantees selected, many of which focused on agriculture, agroforestry, aquaculture and climate information services. Across the portfolio, **three environmental gains appear most consistently:** more efficient and sustainable input use through education and decision support; strengthening responsible tree and forest management through agroforestry, restoration and conservation; and reduced waste and loss across production and value chains through better market connectivity and post-harvest handling.

Services that translate information into simple, practical recommendations that farmers can act on quickly lead to more efficient and sustainable input use. The environmental benefits are often indirect but can become significant at scale. By combining farm-level data, weather information and digital advisory, these services can support climate-smart agriculture by helping farmers adapt decisions on crop management, water use and input application to changing local conditions. Better-timed and more precise decisions can improve resilience to climate variability while also reducing overuse of fertiliser and water, lowering pressure on soils, ecosystems and scarce natural resources.[34,35]

By making soil health testing more accessible, **Crop2X** and **Bizy Tech** helped farmers in rural Pakistan and Tanzania move towards a more targeted use of fertiliser and water, improving timing and dosage. These precision agriculture practices can reduce wasted inputs and lower the risk of nutrient runoff and leaching, which is particularly valuable in contexts where biodiversity is under pressure or water scarcity is persistent.

Where sustainable input practices are already well established, digital services tend to play a different role. Rather than driving major behavioural shifts, they reinforce and formalise existing norms, making sustainable practice easier to maintain and defend.

Monsoon Tea Company worked with forest tea farmers in Northern Thailand who were already largely organic and biodiversity-friendly. The service's added value lay in strengthening ecological understanding and supporting the continuation of these practices, especially where commercial pressures could otherwise incentivise more intensive and environmentally damaging production.

Digital technology has supported responsible tree and forest management by strengthening stewardship behaviours around protection, restoration and sustainable harvesting, rather than by directly demonstrating ecological recovery in the short term. Across the portfolio, this was most evident where digital tools made responsible practices easier to track and verify, strengthened incentives through income protection, premiums and secure markets, and made adoption more feasible through local trust-building and practical training. The clearest short-term evidence was therefore changes in practice, including more sustainable harvesting, improved tree health management, stronger protection of existing trees, and increased planting.

34. Priebe, J. (2021). Digital Innovation for Climate-Resilient Agriculture. GSMA.

35. Getahun et al. (2024). Application of Precision Agriculture Technologies for Sustainable Crop Production and Environmental Sustainability: A Systematic Review.

Vitara digitised the shea value chain in Ghana through traceability, farmer verification and training, paired with tree conservation support through nurseries and community engagement. During the project, Vitara worked with farmers to raise 80,000 seedlings and supported farmers to protect and regenerate shea parklands, with early evidence of behaviour change such as reduced felling and more active protection of existing trees.

InQube combined its app-based farmer support and training with a mangrove restoration pilot in the Sundarbans, India, establishing nurseries and delivering hands-on training so farmers could act immediately. The project reported planting 5,000 mangrove saplings across 10 hectares in the region, with early indications of improved stewardship practices linked to the restoration work.

However, these cases also point to an important limit. Early behaviour change, seedling production and planting are meaningful indicators of progress, but they are not the same as confirmed ecological outcomes. Appropriate siting and aftercare, sapling survival to maturity, sustained gains in tree cover and ecosystem services, and avoidance of harm to surrounding habitats can only be confirmed over time and requires active environmental risk management. **Biodiversity recovery, forest cover change and net carbon stored are typically only measurable through multi-year monitoring and adaptive management**, especially as climate change alters habitats, seasons and the frequency of extreme events, shifting both the definition of success and the risks involved. This is consistent with wider

restoration guidance, which emphasises that technology and monitoring are most valuable when they feed into regular evaluation, corrective action and adaptive management over time, rather than being treated as proof of success in themselves.[36]

DFEC and **J-Palm** both show how systematically collected environmental data can support more sustainable harvesting over time. DFEC's tree health app and traceability system linked community harvesting practices to changes in frankincense tree condition and created a baseline for tracking wider forest cover trends, while J-Palm used mapping data on palm trees to support sustainable harvesting decisions. Together, these cases highlight a familiar pattern: while digital tools can establish baseline records, strengthen traceability and reinforce training, measurable improvements in forest regeneration are difficult to demonstrate without consistent harvesting methods, a shared understanding among harvesters of why data is being collected and how it will be used, and sufficient time for repeat observations.

Digital tools were particularly well suited to reducing waste and loss across production and value chains because they improved the operational coordination needed to move perishable goods more efficiently. Across the portfolio, they helped track produce volumes, quality and timing, strengthen logistics, and improve market connectivity so more output reached buyers and less was lost after harvest. The broader lesson is that digital technology can deliver relatively immediate environmental gains when it helps farmers sell more of what they already produce. By reducing avoidable losses and improving market access, these tools can lessen the need to use additional land, water and inputs to recover income. However, these cases also show that adoption depends on trust: where market norms strongly favour specific grades or appearances, farmers may initially see participation in alternative channels as a reputational or commercial risk.

Farm to Feed faced initial hesitation from farmers to supply rescue-grade produce because market norms and reputation have long rewarded specific produce quality, making participation a cautious, risk-managed decision until trust was built. Once engaged, farmers reported noticeable benefits through reduced losses, more stable income, and less pressure on land, water and inputs to maintain earnings.

The environmental value of digital tools is best assessed by the extent to which they deliver real and lasting benefits in practice, rather than by the novelty of the technology. This reflects a wider lesson from conservation technology: interest in new tools should not be confused with evidence of impact, and their value depends on whether they improve decisions and action on the ground without creating disproportionate new risks or costs.[37] **Even where digital solutions deliver clear ecological benefits, the technology itself and operations behind them can still introduce environmental risks**. Several grantees in the cohort therefore undertook environmental impact assessments to better understand the risks associated with their projects. While these assessments did not reveal major unexpected harms, they were still valuable in helping grantees identify where to focus resources for measuring, managing and strengthening positive environmental impacts, while also anticipating and mitigating potential risks. Processing and transport can add significant emissions, hardware supply chains and shipping carry embedded footprints, and poor waste or wastewater handling can create local pollution risks. Projects should therefore assess not only intended environmental gains, but also operational emissions, end-of-life disposal, rebound effects and other unintended ecological consequences, including the energy, carbon and water footprint of AI and cloud computing where used.

36. WWF. (2019). Forest Landscape Restoration.

37. Wildlabs. (2023). The State of Conservation Technology: 2023.

7. Measuring climate resilience

Through our monitoring, evaluation and learning support to the grantees, we established that although climate resilience was measurable, it was not a single end-state within typical grant timeframes. Tracking resilience as interrelated capacities and decision pathways is a more workable approach, particularly anticipatory, adaptive and absorptive capacity, as reflected in the 3As framing used in BRACED and adopted in UK climate finance measurement guidance.[38]

Tracking resilience as a chain of intermediate capacities and observable decisions that reduce vulnerability over time proved most feasible. Projects produced the strongest evidence when linking service exposure and engagement, such as enrolment, repeat use and channel uptake, to practical shifts in planning, practice and risk management. In practical terms, resilience often manifested as improved anticipatory capacity, for example using hyperlocal weather, pond alerts or demand signals to plan; enhanced adaptive capacity, such as changing planting, irrigation, soil and input decisions or improving storage and handling; and expanded absorptive capacity, such as accessing credit or insurance, receiving faster payments, securing more reliable offtake and reducing losses.

Demonstrating resilience as a durable outcome remained challenging because it is often latent and only fully visible when shocks occur, while attribution is confounded by weather, markets, intermediaries and policy changes. Much of the evidence therefore relied on self-reported survey measures, which are valuable for understanding perceptions and pathways but are sensitive to recall bias and inconsistent interpretations of improvement.

Resilience measurement was most credible when it relied on triangulation between user research and operational or behavioural data. User research helped explain mechanisms of change, constraints, who benefited, who was excluded, and any unintended effects, while operational data provided verifiable proxies and trend signals that could validate, refine or challenge self-reported outcomes. The strongest evidence came from combining self-reports with data trails such as transactions and payment timeliness, insurance enrolment and repayment performance, logistics and waste volumes, repeat advisory engagement, and sensor or test outputs including soil, water or IoT readings. Environmental outcomes were also more credible when framed as early behavioural or efficiency gains, recognising that regeneration and biodiversity recovery require multi-year monitoring.

Farm to Feed can better demonstrate long-term outcomes by combining user centred research with operational data, such as verified rescue-grade volumes diverted from waste, repeat farmer sales, order confirmations, collection reliability and payment timeliness. Taken together, these data can show both reduced post-harvest losses and more predictable cashflow. These are practical manifestations of adaptive and absorptive capacity that are stronger than self-report alone because volumes and transactions can be audited, while anecdotal feedback and insights from users provide the narrative and nuances on how the services are landing and to what extent impact is being felt.

This is a distinct advantage of developing digital climate solutions to track, measure and verify development outcomes, as there is a wealth of data built into the system to analyse. By investing early in data quality, governance and analysis, and resourcing measurement systems as core delivery infrastructure, climate tech solutions can meticulously track impact.

38. Bahadur, A.V., et al. (2015) The 3As: Tracking resilience across BRACED. Working Paper. ODI Global.

8. Scalability and sustainability of digital solutions for climate resilience

Scale can be tracked through indicators such as revenue, employment, users reached and investment raised, although there is no agreed benchmark for when it has been achieved. Our research with alumni of the GSMA Innovation Fund for Climate Resilience and Adaptation suggests that **scale is not viewed as a single endpoint, but as a blend of wider reach and stronger operating capability**. Many startups describe moving beyond pilots by increasing user numbers, improving product reliability and customer value, and strengthening commercial viability through recurring revenue or profitability. Within the two cohorts, agri-focused startups often define scaling as both growth and deeper engagement through bundled services, while agroforestry and non-timber forest product ventures place more emphasis on replication into new markets and building supply chain credibility with larger buyers.

SCALING DEFINITIONS

GROWTH

refers to an increase in users and/or revenue.

SCALE

refers to the ability to expand users or revenue without a corresponding increase in costs or resource constraints.

SUSTAINABILITY

refers to the ability to create value over the long term, financially and operationally, and, where relevant, environmentally and socially.

Most startups are now scaling within existing markets by expanding customer bases or adding features that strengthen their value proposition. Cross-border replication is widely aspired to, but less common in practice and tends to occur in similar operating contexts. Replication has often been enabled by partnerships providing distribution and local delivery capability, sometimes through licensing or white labelling arrangements that allow proven products or modules to be rebranded and deployed by partners in new markets.

As with wider evidence trends in scaling digital innovation,[39,40,41] organic growth remains important, but **multi-stakeholder partnerships are broadly seen as the catalysts that unlock distribution, financing and credibility**, particularly through relationships with funders, banks, MNOs, government institutions and the private sector. White labelling, often used interchangeably with licensing, is emerging as a secondary route to scale. Some teams package parts of their technology as business-to-business products that partners can rebrand and distribute, creating an additional revenue stream to fund expansion without increasing prices for end users. It is typically described as a later-stage option once the product is proven and easy for partners to deploy.

39. Li, B. & Hinrichsen, S. (2023) Scaling Digital Innovation in Emerging Economies - The Impact of GSMA grant funding on start-ups in low- and middle-income countries. GSMA.
40. World Bank (2023). Digital Progress and Trends Report 2023.
41. FAO (2022). Digital innovation strategy for agrifood systems in Africa.

The GSMA supported startups moving from proof to traction by funding delivery, enabling product iteration, and signalling credibility. Many grantees have launched a new tech feature as part of their overall solutions, thus derisking future investment and partnerships. Fund alumni linked support to faster growth, improved customer value, stronger evidence of impact, and practical improvements in internal systems, such as reporting, procurement and financial management.

The most consistent barriers to growth relate to talent and execution capacity, adoption costs, weak infrastructure and difficult operating environments. Where users face tight or irregular cashflows, flexible payment approaches and lower-cost entry points can support uptake, especially when paired with practical onboarding support. This is particularly relevant for digitally-enabled services in rural contexts, where the perceived benefits may be outweighed by time, data costs and uncertainty. Hiring and retaining people with both sector and digital skills is a recurring challenge. Among rural users, low literacy and limited digital confidence increase onboarding costs and drive reliance on agents, call centres and training, which in turn makes growth more resource intensive. Reliable delivery in remote areas is exacerbated by connectivity gaps and the cost of devices and data. Where growth depends on government buyers or tightly regulated sectors, lengthy procurement processes, delayed payments and revised regulations slow progress and strain cashflow.

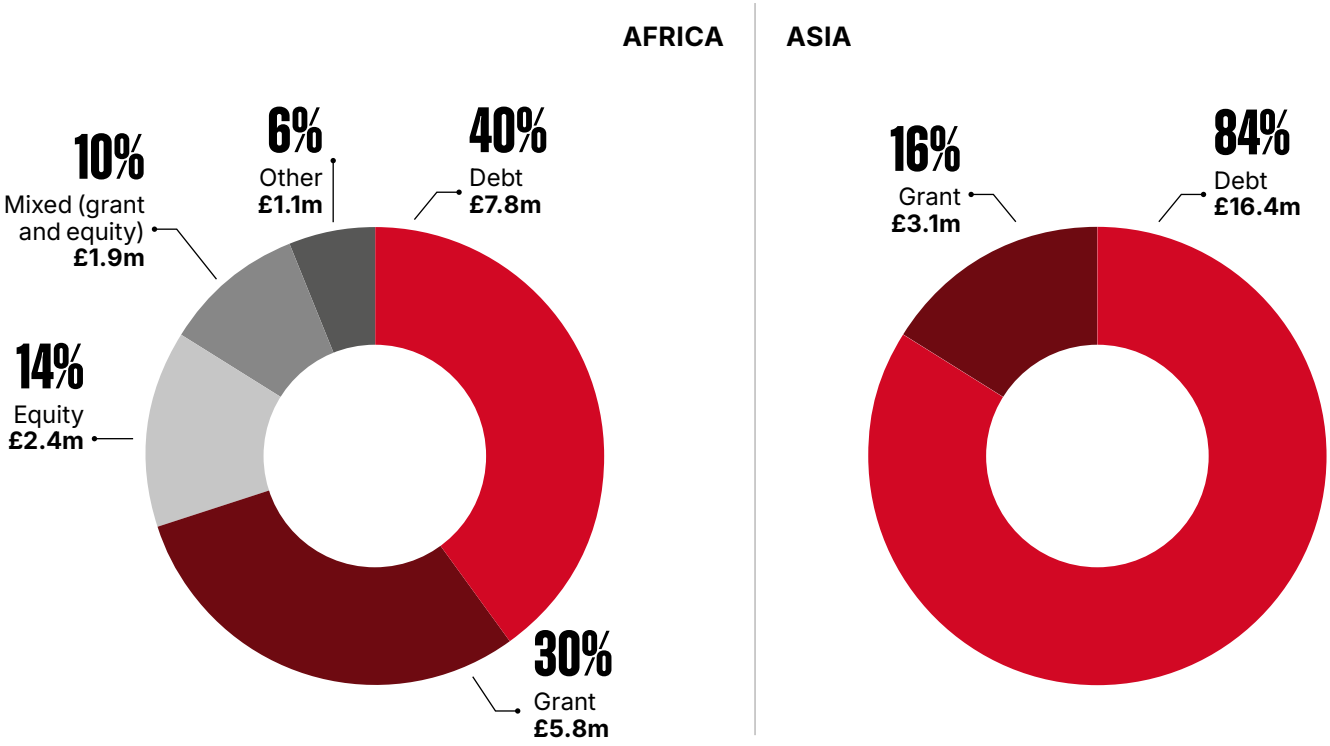
Across the cohort, the grantees have successfully raised £19.6m in follow-on investment. **Follow-on funding patterns point to two distinct scaling pathways for Fund alumni, shaped by who the customers are, where they are located and how revenues are captured**. In Africa, the mix is more finance-oriented, with debt (40%), equity or equity-linked capital (14% equity plus three per cent convertible notes), grants (30%) and blended packages (10%). This aligns with the investor profile, where banks (33%) sit alongside impact (21%) and philanthropic investors (24%), suggesting grantees are scaling through enterprise models that can generate repayments, while catalytic funders help absorb early risk and prove unit economics. In Asia, where projects often collaborate with municipalities and government counterparts, follow-on is predominantly grant-funded (84%) and led by corporates (46%) and government or bilateral donors (30%), reflecting procurement and programme funding cycles, slower monetisation, and greater emphasis on public-good outcomes before commercial capital becomes viable.

In addition to revenue and user growth, several alumni described follow-on capital as a key component of scaling. They also noted that strengthening credibility and investor readiness during the Fund period helped them convert traction and evidence into subsequent fundraising and partnership opportunities.

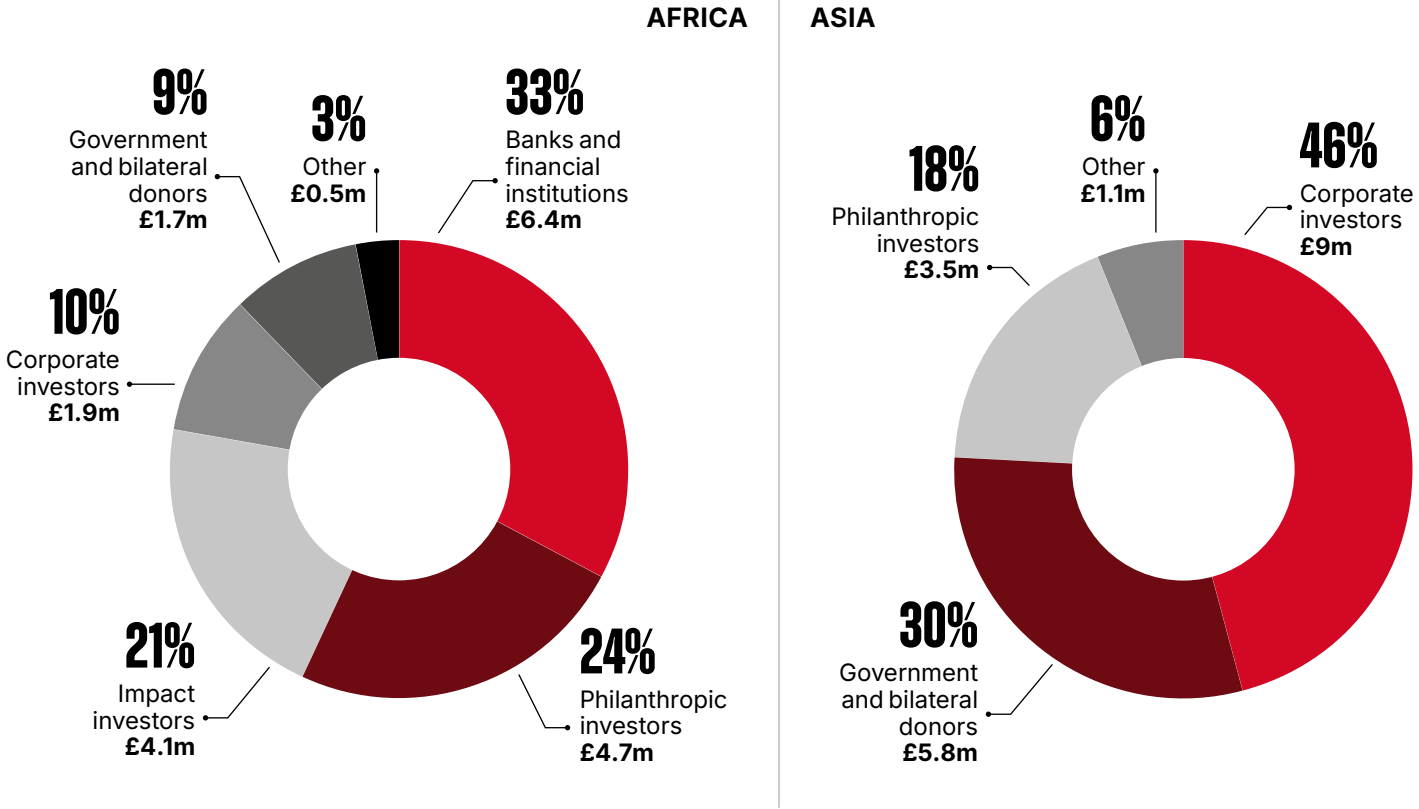
Viewed against the current climate tech funding landscape, these follow-on patterns suggest that Fund alumni are scaling in a market where capital remains available but more selective, with investors favouring clearer revenue pathways and lower execution risk. Rather than indicating a single route to scale, the follow-on funding data points to differentiated capital pathways shaped by business model maturity and purchaser type. In the current funding environment, this may be a strength. Startups that can attract the capital best matched to their operating context are likely to scale more effectively than those forced into a one-size-fits-all financing model.

Figure 3: **Follow-on funding trends**

Funding type



Investor type



£19.6m in follow-on investment raised by Innovation Fund grantees during and post-grant period. Funding amounts have been rounded to two decimal places.

9. Role of the GSMA and MNO partners

A consistent lesson across the portfolio is that the **GSMA's non-financial support was reported by many grantees to be as valuable as grant funding, but its effectiveness depended on how targeted and responsive that support was**. Grantees frequently highlighted the GSMA's convening power, credibility and visibility as factors that appeared to help them access MNOs, attract ecosystem partners and strengthen their position with investors. However, cohort-wide mentoring and standardised capacity building were most useful as a foundation; the greatest value came when technical assistance was tailored to the startup's immediate commercial, operational or fundraising bottlenecks, especially as these evolved during implementation. At the same time, the evidence is stronger on grantee perceptions of value than on the extent to which this support directly changed commercial outcomes.

GSMA's role was strongest when it extended beyond introductions and visibility into more active brokerage. In several cases, the GSMA appears to have added value not only by opening doors, but by helping startups navigate investor due diligence, refine strategy and signal credibility to potential funders. In relation to MNO engagement, support was most effective when early introductions were followed by light-touch but sustained follow-through to maintain momentum through due diligence, integration planning and internal approvals. Progress was most likely where startups could present a clear commercial ask, a demonstrably pilot-ready solution, and a shared roadmap with agreed metrics and responsibilities. **An identifiable internal champion within the MNO was also an important enabler to successful engagement and partnering**, while sustained momentum depended on the startup having sufficient internal capacity to manage both technical and commercial workstreams. Where these conditions were absent, GSMA support alone was generally insufficient to overcome institutional or commercial barriers.

MNO engagement outcomes ranged from stalled conversations to substantive partnerships, with many grantees progressing to a 'pilot, but not yet commercial' stage. The strongest partnerships moved beyond exploratory discussions into concrete commitments, including signed agreements or MoUs, technical integration planning, and a clearer pathway from pilot to scale. Progress was most evident where the MNO addressed a core delivery constraint for the startup, such as payments integration, advisory distribution through operator channels, IoT connectivity, or access to operator data. However, relatively few cases had yet translated into fully commercialised partnerships at the time of reporting, suggesting that progress should be interpreted cautiously.

BKK's ongoing partnerships with Jazz and Zong (China Mobile) illustrates this dynamic, which were instrumental in enabling rapid scale-up during the grant period. Their solution, which included IVR and automatic speech recognition technology for smallholder farmers in Pakistan, sparked MNO interest and helped them secure a partnership with Zong that enabled them to market their digital services to Zong's large rural user base.

However, progress often slowed at the point where technical interest had to be translated into operational or commercial commitments. In many cases, engagement remained at a mid-level: discussions were constructive and some technical or commercial requirements were clarified, but there were no firm timelines, approvals or route to deployment. Common barriers included long procurement and decision-making cycles, shifting priorities, and occasional misalignment between MNO corporate and regional teams. Commercial policies also shaped what was feasible, particularly where preferential pricing, discounts or deeper integration depended on minimum volumes being reached first. In addition, technical, compliance and governance requirements, including integration effort, data security reviews and regulatory or certification issues often extended timelines and, in

some cases, altered the viability of the original partnership model. These constraints suggest that while matchmaking and relationship-building were important, they were rarely sufficient on their own to secure operational delivery or commercial scale.

Hello Tractor illustrates both the potential and the limits of data-based MNO collaboration. The company tested whether Commercial Microwave Link (CML) signals from an operator network could improve local rainfall insights for climate resilience services, building on wider GSMA work showing that attenuation in CML signal strength can be used to estimate rainfall. turning mobile backhaul networks into virtual rain gauges for use cases like improved forecasts, weather-index insurance and data-driven agriculture.[42] While the proof of concept was promising, the more significant barriers to operationalisation were not primarily technical performance, but data governance, security and operational constraints, including questions around what data could be shared and used commercially. These constraints ultimately led Hello Tractor to rely more heavily on alternative data sources, including GIS and open weather models. Although uneven microwave link coverage may affect applicability in some contexts, this appears to have been a secondary limitation rather than the main factor constraining scale.

42. Priebe, J. (2021). Digital Innovation for Climate-Resilient Agriculture – Using rainfall data from mobile networks for localised and scalable services. GSMA.

RECOMMENDATIONS

The following takeaways translate portfolio evidence into practical guidance for startups, investors and donors on how to design, fund and partner for climate resilience impact at scale.

STARTUPS

1.

Build services that can keep working during disruption.

Design products and delivery models to keep working when climate shocks or wider instability affect logistics, data, payments or customer demand. Build in continuity through backup suppliers, local support, offline processes and clear fallback options when conditions change. This includes identifying critical operational dependencies early and reducing reliance on single suppliers, data sources or channels where possible.

Example actions:

- Create a simple continuity plan that lists at least five operational dependencies most likely to interrupt service delivery, names a backup for each one, and assigns responsibility for switching to that backup when disruption occurs.
- Run at least one disruption simulation per year, such as mobile network loss, delayed stock delivery or agent unavailability, and document what still worked, what failed and what changes are needed to protect core service functions.

2.

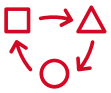
Prioritise building user trust in services to drive adoption.

Focus on reliable delivery, clear value and strong first user experiences. Demonstrations, trusted intermediaries and assisted onboarding can help build confidence, while simple entry points can support adoption before users are ready for more advanced features. In lower-trust or lower-literacy settings, startups should plan for hybrid delivery models that combine digital tools with human support and familiar local structures.

Example actions:

- Choose onboarding and engagement channels that match how target users already access information and services, such as cooperatives, agents, extension workers or local groups, and track which channels lead to sustained use rather than one-off sign-up.
- Reduce the perceived risk of trying the service without weakening its value proposition, for example through demonstrations, pay-as-you-go pricing, small starter packages or clear proof of results, rather than relying on fully free offers that may be hard to convert into paid use.

3.



Evidence impact through step changes and longer-term measurement.

Track early signs of change, such as repeat use, improved decisions and uptake of new practices, and continue measuring across multiple cycles where possible. A small set of consistent metrics, backed by user and field evidence, can support both learning and fundraising. Startups should distinguish clearly between outputs, intermediate outcomes and longer-term change, and where possible combine self-reported outcomes with operational data such as transactions, repayment, repeat use or verified service activity.

Example actions:

- Define a results chain with no more than four stages, for example registered users, active users, users adopting a promoted practice, and users reporting a business or resilience benefit, and review the drop-off between each stage every quarter.
- Validate self-reported changes by checking them against operational records, such as whether users who say they adopted advice also show repeat purchases, completed repayments, higher platform activity or verified use of the service over time.

INVESTORS AND DONORS

1.

Fund the full service, not just the product.

Support the practical functions that help services work day-to-day, including onboarding, training, maintenance, quality checks and user support. These elements often determine whether a solution is used consistently and delivers results beyond a pilot. Funding should also recognise the costs of hybrid delivery, local field operations and data quality assurance where these are essential to adoption and impact.

Example actions:

- Encourage investment applicants to submit a delivery-cost breakdown that separates product development from onboarding, training, field operations, customer support, maintenance and monitoring, and assess whether the non-technical functions are adequately funded.
- Include budget lines for the human and operational components needed to make the service usable in practice, such as agent networks, refresher training, device maintenance, call centre support or data verification.

2.

Align funding and milestones with the business model.

Tailor support to how the startup will generate revenue and scale. Solutions serving governments, municipalities or other organisations may need more time and working capital, while those serving low-income users may need support for affordable pricing, flexible payments and trusted distribution. Milestones should reflect the underlying business model and may need to track integration, procurement, user retention or channel performance, not only short-term revenue growth.

Example actions:

- Set milestones that match the route to scale, such as contract renewal, procurement approval, integration completion, repayment performance or six-month retention, rather than relying only on top-line revenue or user acquisition targets.
- Structure disbursements around expected cashflow constraints, by providing working capital where revenue is delayed by procurement or seasonal demand.

3.

Support measurement of real change.

Focus on evidence of behaviour change and sustained use, not only delivery metrics such as registrations or devices distributed. Simple, comparable metrics combined with user feedback can help strengthen both learning and future investment decisions. Donors should support measurement systems early, encourage triangulation between user research and operational data, and avoid expecting robust evidence of resilience or ecological impact within short grant windows unless longer-term follow-up is funded.

Example actions:

- Agree a small set of required indicators at the start of funding, including at least one usage metric, one retention metric and one behaviour-change metric, and review them consistently across the life of the grant or investment.
- Encourage triangulation by pairing user survey data with verifiable operational data, such as sales volumes, payment timeliness, repayment rates, advisory engagement or service usage logs.

CONCLUSION

The GSMA Innovation Fund for Climate Resilience and Adaptation portfolio demonstrates that digital technology can strengthen climate resilience in LMICs when it supports practical decisions and is built for real constraints. The strongest solutions helped users act on immediate real-world priorities such as protecting yields and incomes, preparing for shocks, and reducing losses.

Delivery conditions shape outcomes as much as product design. Volatility in purchasing power, connectivity gaps, supply disruption, regulatory uncertainty, and reliance on third-party data often determined what could be delivered. Where solutions relied on AI, IoT or other emerging technologies, teams also faced internal complexity linked to data quality, model performance, and operational readiness. Progress was fastest when teams validated assumptions early, iterated with users, and simplified features to match local capacity.

Users engage with services that are credible, easy to understand, reinforced through demonstrations, community-based agents and familiar channels such as SMS, USSD and messaging platforms, and backed by reliable fulfilment through payments, logistics, inputs, or support. This hybrid approach also enabled inclusion, especially when services reflected women's constraints around time, access, literacy and decision-making, and connected them to dependable markets and affordable finance.

Overall, the portfolio suggests that the most consistent climate resilience outcomes were improved income stability and reduced financial uncertainty. Where services also helped users act on information, environmental benefits were evident, particularly through more precise input use, reduced losses and stronger stewardship. Moving from these outcomes to scale depended on partners removing binding constraints. The GSMA's convening power and tailored support helped grantees build the capability and partnerships needed to succeed.

ANNEX: GRANTEE PROFILES

THE GSMA INNOVATION FUND FOR CLIMATE RESILIENCE AND ADAPTATION

BaKhabar Kissan (BKK)

BKK received a GSMA Innovation Fund grant to enhance its digital weather platform for smallholder farmers by expanding hyperlocal data coverage and improving forecast accuracy. BKK deployed 155 automated weather stations across Pakistan's agricultural centres, largely in underserved rural areas, and applied AI algorithms for data analysis and pattern recognition to deliver more timely and precise weather information that supports farmers to manage weather-related risks. The project also piloted an automatic speech recognition system for Urdu to strengthen IVR and call-centre services, successfully deploying it in three districts in Punjab. Pakistan's highly diverse language landscape increased the complexity of building reliable speech and language models and therefore scaling voice and advisory services beyond initial regions required careful product design and significant dataset investment.

→ Read the full case study.

Country: Pakistan

Sector: Agriculture

Business model: B2C

Resilience capacity: Climate adaptation, climate preparedness and planning

Find out more: www.bkk.ag

BENAA

BENAA received a GSMA Innovation Fund grant to deploy smart decentralised wastewater treatment and reuse systems for underserved rural communities in Egypt. The project expanded BENAA's solar-powered SuWaCo units and added an IoT monitoring layer to track treated water quality and usage in real time, allowing faster maintenance responses and safer reuse of water for irrigation. Farmers were able to access nutrient information through a mobile app to optimise fertiliser use, while communities benefited from reduced sewage overflow and contamination of canals. BENAA installed 10 IoT-enabled wastewater treatment units, reached 21,180 people, and treated and reused 50.4 million litres of wastewater for irrigation. The project highlighted how significant payment design was for sustainability. Integrating mobile money (via Paymob) supported subscription collection and reduced default rates.

→ Read the full case study.

Country: Egypt

Sector: Water

Business model: B2C

Resilience capacity: Climate adaptation

Find out more: benaafoundation.org

CoAmana

CoAmana received a GSMA Innovation Fund grant to scale Amana Market, a digital version of Nigeria's traditional market hubs that connects smallholder farmers to buyers, inputs and productive assets such as drought-resistant seeds and solar irrigation pumps. The service expanded access through a web platform, mobile app and USSD, and delivered localised weather updates and climate-smart agronomic advice through SMS. The project enabled CoAmana to reach more than 86,000 people and support over 21,000 farmers to adapt to climate change, with most farmers reporting higher yields and incomes, and improved access to timely weather information. Resilience gains accelerated when women accessed advice and secured productive assets. CoAmana's lease-to-own solar irrigation pilot showed strong demand, but results were contingent on designing finance, delivery and training around women, and engaging communities so women retain control over the asset and its benefits.

→ Read the full case study.

Country: Nigeria

Sector: Agriculture

Business model: B2B, B2C

Resilience capacity: Climate adaptation

Find out more: coamana.com

Crop2Cash

Crop2Cash received GSMA funding to connect smallholder farmers in Nigeria to crop insurance and high-yielding, drought-resistant seeds through a USSD marketplace supported by an AI-powered IVR weather advisory. The solution expanded access to financial and climate services for farmers who need to adapt to changing weather patterns but are often excluded from formal finance. Higher yields were reported by 92% of farmers and 96% reported increased income. Crop2Cash learned that scaling digital agriculture services works best when simple, local-language digital tools are paired with trusted human channels such as radio and extension agents to drive awareness and last-mile adoption, and when services are bundled through partnerships so inputs, advisory, insurance and weather are aligned to seasonal needs. Crop2Cash also learned that women play a central role across planting, weeding, harvesting and post-harvest activities, leading the team to prioritise women as a key user group.

→ Read the full case study.

Country: Nigeria

Sector: Agriculture

Business model: B2B, B2C

Resilience capacity: Climate adaptation

Find out more: crop2cash.com.ng

Dayaxa Frankincense

DFEC received support from the GSMA Innovation Fund for Climate Resilience and Adaptation to build two tools: a blockchain traceability app to log where resin is tapped and how much harvesters are paid, and a tree-health app to monitor frankincense trees. Each activity was designed to operationalise locally-led adaptation principles. By recording origin and price on-chain and sharing the data with buyers, DFEC ensured transparency and accountability in a supply chain long plagued by opacity and human rights concerns. Paying harvesters at the point of purchase reduced the influence of exploitative intermediaries and gave producers more control over when and how they sell to remove structural inequalities and improve bargaining power. During the grant, DFEC supported 1,300 harvesters to adapt to climate change, with many reporting fairer payments and improved financial stability. While trust barriers, connectivity and security slowed scale-up, the project demonstrated that digital traceability and participatory monitoring can strengthen livelihoods and forest stewardship, putting community actors at the centre of climate-resilient value chains.

→ Read the full case study.

Country: Somaliland

Sector: Agroforestry and NTFP

Business model: B2C

Resilience capacity: Climate adaptation

Find out more: dayaxafrankincense.com

GeoKrishi

GeoKrishi received a GSMA Innovation Fund grant to expand its digital agriculture platform in Nepal, helping smallholder farmers access hyperlocal weather information and climate-smart advisory. The project reached 237,300 people and supported 51,500 farmers to adapt to climate change, with 97% reporting better access to localised weather information and 96% acting on climate-smart recommendations. GeoKrishi upgraded its farmer app with digital learning content on climate-smart practices, delivered training via webinars and in-person e-Chautari community clinics, and built an enterprise app for municipalities and cooperatives to use map-based analytics and monitoring dashboards. Blended delivery increased adoption of climate-smart practices. Combining app-based content with webinars and in-person e-Chautari clinics helped translate advice into action for farmers with varying literacy and connectivity levels.

→ Read the full case study.

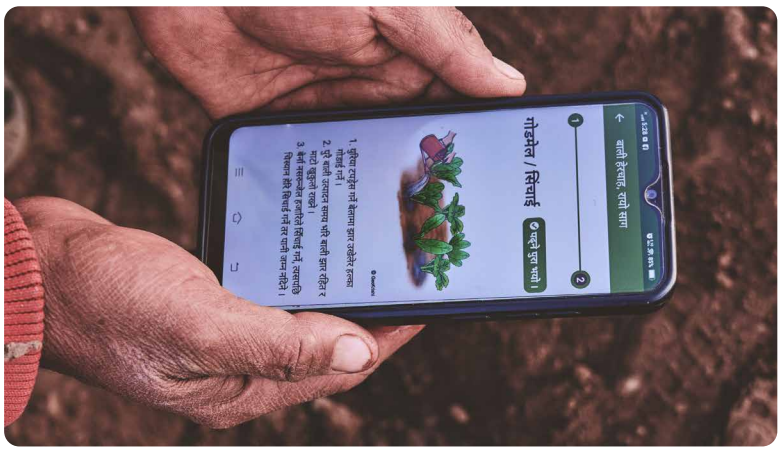
Country: Nepal

Sector: Agriculture

Business model: B2B, B2C

Resilience capacity: Climate adaptation, climate preparedness and planning

Find out more: geokrishi.farm



Hello Tractor

Hello Tractor used its GSMA Innovation Fund grant to develop a predictive tool that links weather and other variables with expected tractor demand, helping inform where and when services are likely to be needed. The tool was piloted with 10 new pay-as-you-go tractor owners, 15 outreach workshops, and the development of training tools for 600 farmers and digital marketing materials that reached 3,541 farmers. Adoption improved when complex analytics were translated into simple decisions that reflected how customers operate, for example by turning forecasts into clear booking recommendations in high-demand areas. Trust-building and community engagement were essential to sustain usage and grow the customer base.

→ Read the full case study.

Country: Nigeria

Sector: Agriculture

Business model: B2B, B2C

Resilience capacity: Climate adaptation, climate preparedness and planning

Find out more: hellotractor.com

J-Palm

J-Palm received GSMA funding to deploy a mobile blockchain app that enabled full traceability from palm fruit to palm oil and palm kernel, and a mobile app to track tree health and carbon storage. More than 3,000 palm harvesters and collectors now use the apps, and the grant also supported the distribution of manual mini-mills to extend J-Palm's processing model to 30 communities. The solution delivered commercial and productivity benefits by improving oil extraction and reducing processing time and water use, helping to stabilise incomes even in cash-based environments. J-Palm demonstrated that in low-connectivity contexts, direct onboarding by company staff can be more effective than relying on intermediaries, and value needs to be visible in day-to-day operations, even where mobile money adoption remains limited.

→ Read the full case study.

Country: Liberia

Sector: Agroforestry and NTFP

Business model: B2B, B2C

Resilience capacity: Climate adaptation, environmental conservation

Find out more: jpalmliberia.com

Lersha

Lersha received a GSMA Innovation Fund for Climate Resilience and Adaptation grant to scale its one-stop digital agriculture platform in Ethiopia, combining climate advisory, input and mechanisation access, and bundled finance with climate-risk insurance. The platform is delivered through SMS, an in-house call centre, a mobile app and a network of Lersha youth agents who build detailed farmer profiles to enable personalised advisory and support for financial services. The project reached 1.9 million people, supported 474,000 farmers to adapt to climate change, and enabled 76,000 users to access loans. The project highlighted how bundling services increased resilience value for farmers. Combining climate information with inputs, mechanisation, and finance plus climate-risk insurance made it easier for farmers to act on advice rather than just receive it.

→ Read the full case study.

Country: Ethiopia

Sector: Agriculture

Business model: B2B, B2C

Resilience capacity: Climate adaptation, climate preparedness and planning

Find out more: lersha.com

Komunidad

Komunidad received GSMA funding to support local governments and vulnerable communities in the Siargao Islands following Typhoon Rai in December 2021 by strengthening disaster preparedness through a data-driven early warning system. The project integrated environmental intelligence and alerts across four interfaces, including a web dashboard, a mobile app, SMS alerts for municipalities, and a public web app for residents and tourists. The pilot reported that 97% of disaster officials were better able to anticipate typhoons despite connectivity constraints, supporting earlier action and coordination. Komunidad demonstrated that early warning systems have greatest impact when climate data is localised, embedded in government workflows, and paired with capacity building, while retention and continuity can be threatened by leadership changes and regulatory hurdles without long-term agreements and proactive regulatory engagement.

→ Read the full case study.

Country: Philippines

Sector: Early warning systems

Business model: B2B, B2G

Resilience capacity: Climate adaptation, climate preparedness and planning

Find out more: komunidad.global

Simusolar

Simusolar received an Innovation Fund grant to develop and commercialise an IoT-enabled fishing light that is energy efficient, locatable and trackable, and to launch an app that helps fishers track usage, monitor weather conditions, and manage fishing operations. The tracking capability also enabled Simusolar to share anonymised data with the Ministry of Fisheries to support fisheries digitalisation. Fishers reported 15% higher catches than with competitor lights. Simusolar established that even when market demand is clear, successful launch depends on navigating operational and regulatory requirements in close collaboration with government, and to adapt product features to local user preferences, such as offering SMS-based listings rather than map-based interfaces, to support adoption and retention.

→ Read the full case study.

Country: Tanzania

Sector: Aquaculture and fisheries

Business model: B2C

Resilience capacity: Climate adaptation, environmental conservation

Find out more: simusolar.com

GSMA INNOVATION FUND FOR CLIMATE RESILIENCE AND ADAPTATION 2.0

Aloi

In Nepal, smallholder dairy farmers rely on rainfall for livestock feed, but changing patterns brought on by global warming have decreased forage and milk production. The sector also struggles to access finance to expand fodder production, adopt alternative energy such as biogas, buy insurance and upgrade refrigeration. Many of these micro-entrepreneurs operate informally and find it difficult to secure loans due to limited credit history, proof of income, or collateral. These constraints reduce their ability to invest in technologies and practices to support climate adaptation.

Aloi helps informal entrepreneurs access business finance, with a focus on green sectors. Aloi's technology increases lenders' confidence to lend to micro-entrepreneurs through automated loan monitoring and the use of alternative credit data.

Aloi received funding from the GSMA to strengthen financial inclusion for dairy farmers in rural Nepal and to support their adoption of climate-smart agroforestry practices. The grant supported the development of a digital platform for credit profiling, enabling cashless affordable loans to be spent with accredited green and sustainable vendors (for example, biogas equipment suppliers), and enabling loan repayment through milk sales. Through the project, over 1,200 dairy farmers were given digital credit profiles, improving their ability to access financing.

How does the solution work?

→ Marketing

Aloi promotes the service through dairy cooperatives and cooperative unions, using organisations such as CDCAN to build credibility. The team runs in-person briefings, climate-smart agriculture and financial literacy sessions, and follow up coaching to show practical benefits. They also engage milk buyers so farmers can see improved market access and clearer transactions.

Country: Nepal

Sector: Agriculture

Business model: B2B, B2C

Resilience capacity: Climate adaptation, climate shock absorption

Find out more: aloi.global

PROJECT IMPACT

5.2K
people reached

1.2K
farmers supported

400+
loan applications

27
loans facilitated

100%
repayment

→ Registration

Onboarding starts with the cooperative, which is supported to digitise milk collection and farmer records. Farmers are then enrolled via the cooperative so the platform can build income and production histories. Banks and finance partners then connect with approved input vendors and buyers.

→ Business model

The business model combines a service subscription with transaction-based fees. By the end of the grant, cooperatives were charged on a subscription basis for the milk collection module, typically scaled to cooperative size and milk volumes. To support early adoption, Aloi offered loan processing free of charge rather than testing a loan service fee during the grant. Financial institutions can pay for improved credit assessment and monitoring, and vendors and buyers can pay commissions or fees on facilitated payments and sales.

→ Mobile and digital technology features

The platform records daily milk deliveries to create an alternative credit history, then applies automated credit profiling using alternative data and a psychometric questionnaire. Loan applications and monitoring are integrated with partner banks. Disbursement can be managed through SMS-enabled tokens redeemable via accredited vendors.

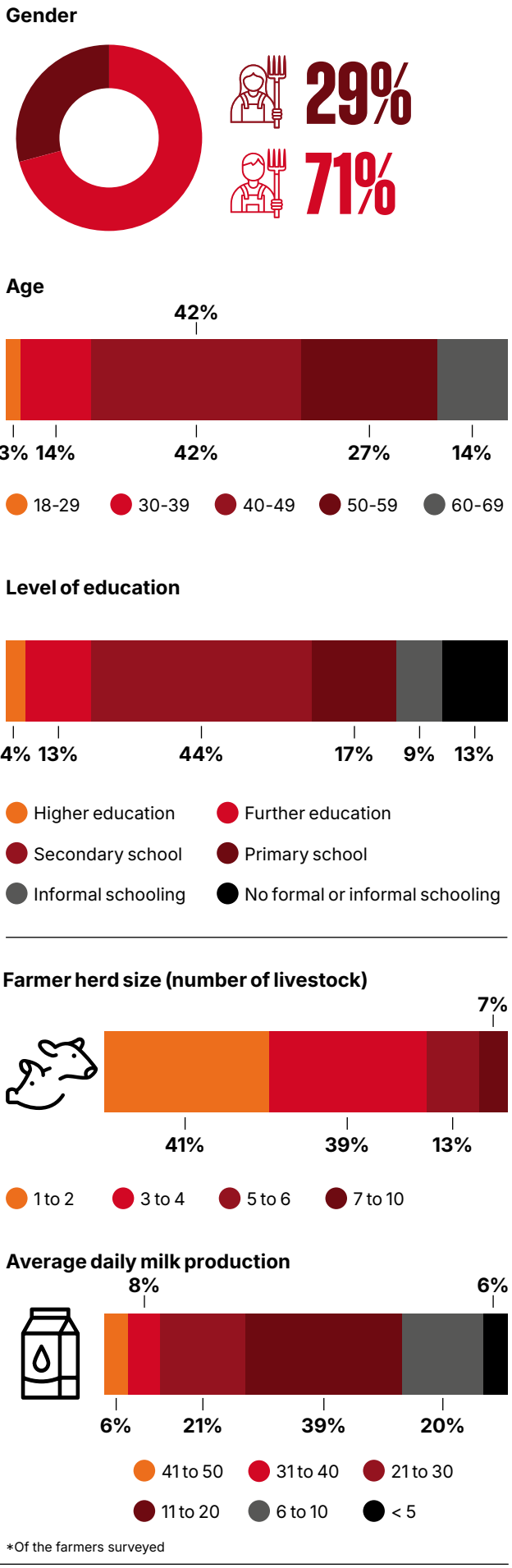
→ Offline, low-tech or no-tech features

Delivery is supported offline for low-connectivity settings. Staff and cooperative leaders provide local language training on financial skills and climate-smart farming, and hands-on help to shift from paper records to simple digital workflows. E-learning content can be shared for households to revisit when convenient.

Who uses Aloi?

A typical user of Aloi's services is a smallholder farmer who is approximately 47 years old and has completed primary school education. They are most likely to own between one and four cows and produce less than 30 litres of milk per day, with a personal monthly income of less than NPR 50,000 ($360). Overall, the profile of farmers surveyed is broadly consistent with national averages for gender and age of farmers in Nepal,[43] as well as herd size and daily milk production.[44]

Figure 4: Farmer profile*



*Of the farmers surveyed

43. National Statistics Office (2022). National Census of Agriculture.

44. UNCDF (2020). Where To Start When Digitizing Payments for Dairy Farmers in Nepal.

Building climate resilience - what changed for farmers?

Improving financial resilience and climate shock absorption

Aloi expanded access to financial support by creating credit profiles for smallholder dairy farmers who lacked formal credit histories and were often excluded from banking services. This foundation can strengthen farmers' ability to plan, invest and recover after climate shocks by improving access to more affordable finance. Aloi's loan pathway links farmers to formal lending with repayments deducted from milk sales, helping to smooth cashflow. While only a small number of loans were disbursed by the end of the grant period, repayment performance was strong, with 100% of repayments made on time.

Improving knowledge and practices to support adaptation to climate stressors

Adaptive capacity improved through onboarding that paired climate-smart dairy practices with financial literacy. Among Aloi farmer service users included in the survey, 98% participated in the training. Farmers described acting on advice such as improved feeding and breeding, disease prevention and vaccination, changes that can help protect milk yields during heat stress, disease outbreaks and erratic rainfall. Financial capability gains were similarly strong, with 86% reporting improved money management knowledge and skills.

LOAN APPLICATION INSIGHTS

95%

of farmers requested a loan for buying more livestock

50%

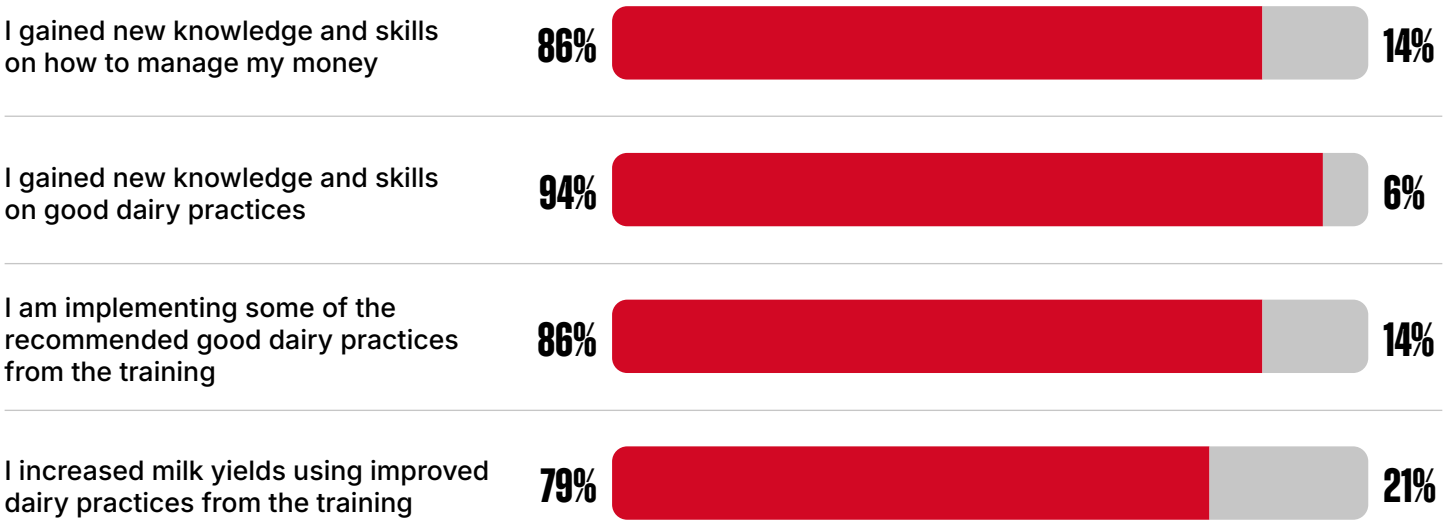
of farmers requested a loan between NPR 100,000 to 200,000 ($700 to $1400)

Data is from a small sample of Aloi farmer service users

Farmer impact survey

Is the climate-smart dairy farming and digital literacy training helpful?

SHARE OF FARMERS RESPONDING YES OR NO



Of the Aloi farmer service users included in this survey, 98% participated in the training.

Improving environmental sustainability and green investment

Environmental sustainability was supported through training on environmental protection and sustainable land and community forestry management, together with investments such as biogas equipment, improved fodder and herd management to increase on-farm resource efficiency. Loans were structured to be spent via accredited green vendors, supporting more controlled use of finance towards intended investment categories.

What did we learn?

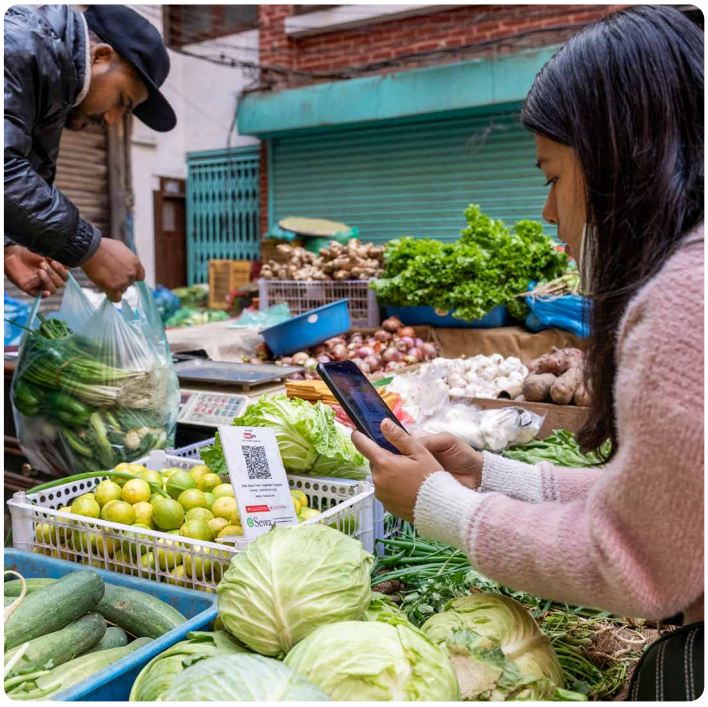
Borrowing behaviour is shaped by habit and convenience. Most farmers relied on cooperative loans (61%), followed by family and friends, while only 26% had borrowed from a bank or microfinance institution prior to Aloi. Although 86% reported an attempt to access bank loans, farmers did not frame bank access as the main issue. They preferred cooperative borrowing, even at high interest rates, because it is familiar, fast and embedded in everyday cashflow. Aloi's value proposition is to improve credit delivery and management through cooperatives, including clearer repayment pathways and more structured support for planning and productive investment.

Women farmers face distinct constraints. These included time poverty, literacy barriers, and lack of land collateral. More flexible formats, such as voice-enabled inputs and SMS-based tools, supported engagement and understanding, while savings and deposit tracking helped build evidence of reliability and supported wider access to finance.

Fit with cooperative routines drives adoption but can reduce transparency for farmers. Farmers were most willing to participate when the process fit within familiar cooperative routines such as milk collection and fortnightly payments, and when repayments were deducted automatically. However, this convenience also reduced farmers' visibility over instalments, as cooperatives handled most steps. A third of farmers did not fully understand the loan token mechanism or found accredited vendors too limited, suggesting that clarity of product design and vendor relevance directly affect perceived value. Those who used the token described it as simpler than cash or bank-based processes, and loans were generally used for their intended purposes, most commonly livestock purchases.

Cooperative capacity varies significantly, shaping who benefits most. Smaller cooperatives typically had less ability to support farmers with financial planning, and their members often had weaker access to financing than those in larger cooperatives. As a result, Aloi prioritised working with small and medium cooperatives to better reach farmers with the greatest need, while providing a clearer service layer to close capability gaps. Farmers reported that Aloi's training strengthened financial planning and management, and that the loan application process felt easier than expected due to continued guidance throughout the journey.

Partnerships accelerated scale and credibility. Working through umbrella bodies and semi-government organisations helped build trust and extend reach. Technical assistance strengthened stakeholder engagement, pricing strategy, and positioning, supporting Aloi as a business development partner as well as a technology provider.



Bizy Tech

Country: Tanzania

Sector: Agriculture

Business model: B2C, B2B, B2G

Resilience capacity: Climate adaptation

Find out more: bizytech.com

Tanzania is experiencing the impacts of climate change, with rainfall becoming less reliable and extreme weather events increasing in frequency and severity. These shifts raise risks for rural livelihoods and food security, and they are likely to intensify as population growth increases pressure on land and water resources. Together with overgrazing and intensive farming, climate change is also exacerbating soil degradation due to erosion, nutrient depletion, low organic matter, and acidity or high salinity. Smallholder farmers are on the frontline of these changes, but many lack the data and support needed to make confident decisions in an increasingly volatile climate. Soil health insights are a critical gap, and without affordable, accessible soil testing, farmers struggle to identify nutrient depletion or rising acidity, which can lead to mismatched fertiliser use, wasted spending and stunted yields. Combined with erratic rainfall and higher temperatures, this uncertainty accelerates soil degradation and deepens vulnerability over time.

Bizy Tech is a Tanzanian startup addressing this challenge by digitising parts of the agricultural ecosystem and making soil and agronomic insights easier to access. Through its Kilimo Bora service, Bizy Tech provides AI-driven agronomy, weather- and location-specific recommendations, and pathways to improve market access and financial inclusion. Farmers can receive guidance through the Kilimo Bora app or via SMS and USSD on any handset, supported by field teams and village-based advisors (VBAs) who build trust and help farmers interpret results.

With GSMA funding, Bizy Tech strengthened its soil health testing and farm advisory services by developing AI and satellite imagery-based soil analysis and messaging, complemented by onsite sampling and portable kit testing.

PROJECT IMPACT

155K
people reached

26.2K
farmers supported

66
agribusinesses supported with data-driven climate adaptation

$1.1M
additional investment unlocked

How does the solution work?

→ Marketing

Bizy Tech promotes the service through on-the-ground engagement that builds trust in the advice, using VBAs, live demos and demo plots, with targeted outreach that has been particularly effective for women farmers. Growth has also been driven by expansion into multiple regions and by delivery partnerships and programmes that bring in new farmer groups through established networks.

→ Registration

The core users are Tanzanian smallholder farmers, with a strong focus on women and youth-led agribusinesses, who can be onboarded and supported by field teams and VBAs. They can then

access the service through the Kilimo Bora mobile app or by signing up and interacting through USSD and SMS on any handset, which helps include farmers with limited connectivity or smartphone access.

→ Business model

The model is a hybrid of marketplace and advisory revenues, with initial onboarding often free to drive uptake, followed by monetisation through tiered input and output marketplace transaction fees, paid advisory subscriptions and value-added services such as soil testing (priced per sample with tiered options), alongside licensing and partnership arrangements, and collaborations that support payment collection and service delivery.

→ Mobile and digital technology features

Kilimo Bora combines AI-driven agronomy with weather- and location-specific recommendations, using multiple delivery channels (app, SMS and USSD) so farmers receive timely guidance on soil health, fertiliser and input use, planting decisions and crop management. The solution blends field kit results for plot-level precision with satellite data for broader trend analysis, and is linked to digital payments and billing integrations to simplify access and collections.

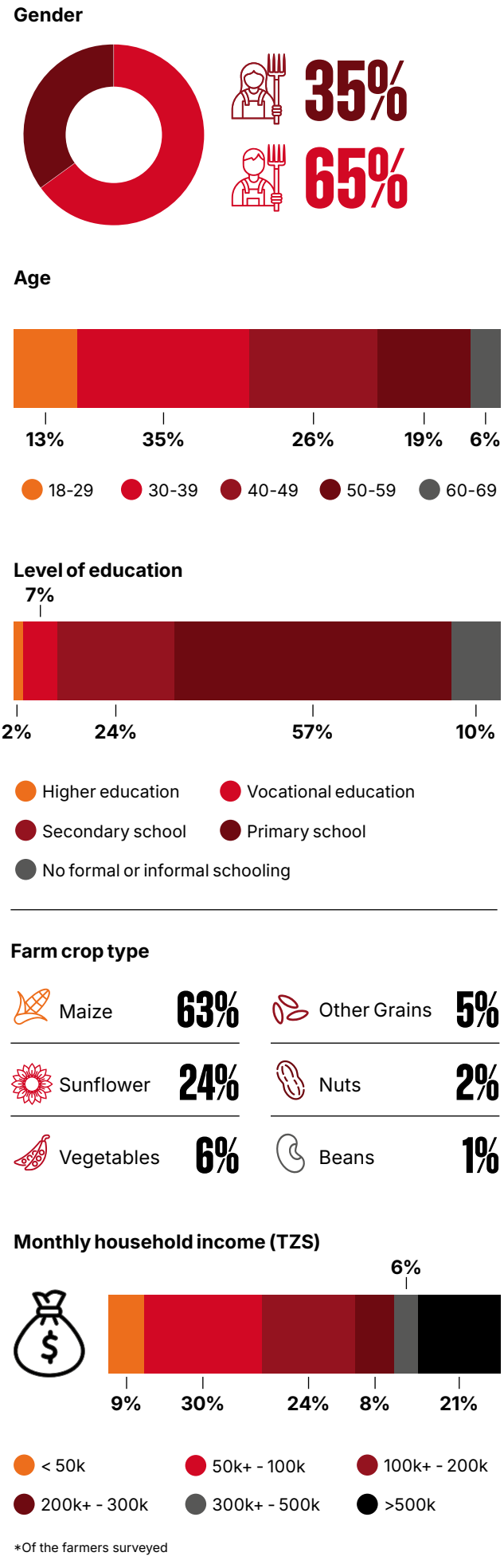
→ Offline, low-tech and no-tech features

The service relies heavily on field delivery to make advice credible and actionable, including portable soil health testing toolkits used during farm visits, farmer training and kit calibration support, physical sampling workflows (including group bookings and drop-off options) and a last-mile network of VBAs, agronomists and delivery points that help farmers act on recommendations even where digital literacy is low or mobile networks are unreliable.

Who uses Bizy Tech?

A typical user of Bizy Tech services is a smallholder farmer managing a one- or two-hectare farm, who is approximately 41 years old and has completed primary school education. They are most likely to cultivate maize as a primary crop, with a personal monthly income of less than TZS 200,000 ($74). Overall, the profile of farmers surveyed is broadly consistent with national averages for farm size, crop type, income and education level.[45,46]

Figure 5: Farmer profile*



*Of the farmers surveyed

45. The United Republic of Tanzania (URT) (2024). The 2022 Population and Housing Census: Tanzania Basic Demographic and Socio-Economic Profile Report.

46. Tanzania National Bureau of Statistics (2024). Annual Agriculture Sample Survey 2022/23.

Building climate resilience - what changed for farmers?

Improving knowledge and practices to support adaptation to climate stressors

Farmers reported that Kilimo Bora improved day-to-day decision-making by combining practical training with SMS/USSD/app advice informed by soil and weather data. Over 85% of surveyed users said they implemented some or all recommendations, including adjusting planting dates and crop variety choices to better manage erratic rainfall and heat stress. Training feedback reinforces this shift, with most participants reporting learning new practices and changing how they farm.

By putting soil health at the centre of farm planning, the service strengthened farmers' ability to respond to climate stressors that reduce yields over time. Before engaging with Kilimo Bora, many farmers reported low confidence in soil knowledge, with three in four users reporting improved soil health after using the service. However, these improvements are primarily self-reported, and measurements or definitions of soil health improvement were not consistently standardised across respondents.

Recommendations encouraged more targeted fertiliser and input application, helping farmers reduce mismatched use that can degrade soils and waste money. Around 80% of farmers reported purchasing the recommended inputs.

ADOPTION RATE

80%

of farmers report having bought Kilimo Bora's recommended inputs

BARRIERS FOR NON-ADOPTERS

56%

found it too expensive

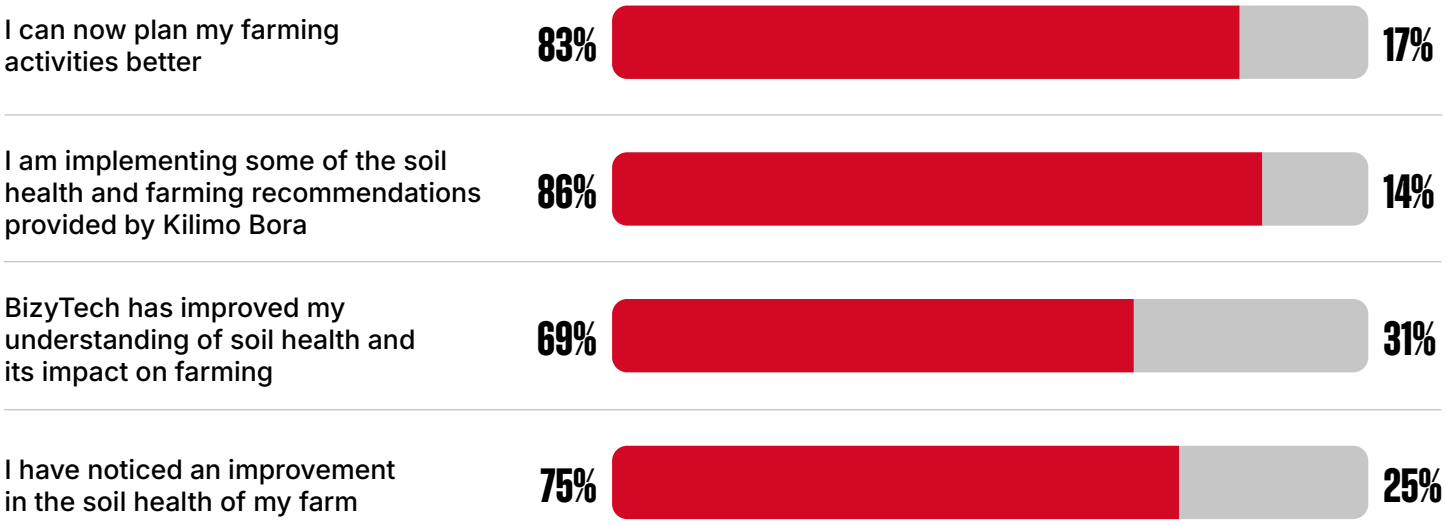
49%

said inputs were not in stock

Farmer impact survey

Are the soil health and good farming practice recommendations helpful?

SHARE OF FARMERS RESPONDING YES OR NO

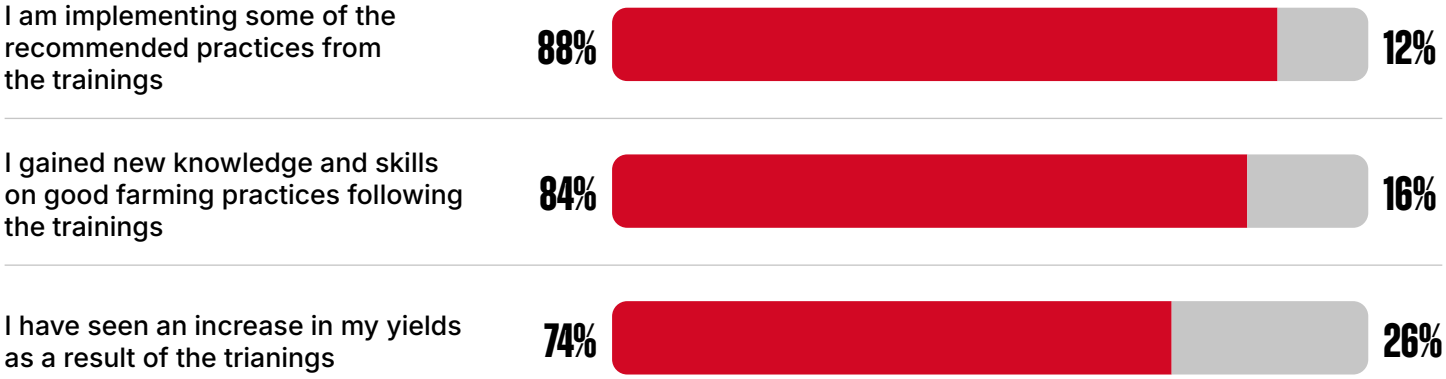


Of the BizyTech farmer service users included in this survey, 98% participated in the training.

Farmer impact survey

Are the climate smart agriculture trainings helpful?

SHARE OF FARMERS RESPONDING YES OR NO



Those who did not stated it was because the suggested inputs were too expensive or were unavailable in local markets. Where advice was followed, farmers described applying fertiliser more carefully and selecting inputs better aligned to soil conditions, supporting productivity while reducing unnecessary application and potential runoff impacts.

What did we learn?

Trust and education are the foundation for demand. Soil health services worked best when farmers understood and trusted the evidence supporting the advice. Satellite imagery increased speed and reach, but many farmers still expected soil testing to be a physical, in-field activity, so confidence dropped when recommendations seemed to rely on satellite readings alone. Uptake improved when satellite insights were used to target fields and spot trends, then validated through onsite sampling and portable kit-based tests that aligned closely with laboratory results.

Sensitisation and follow up were then essential to turn credibility into demand by helping farmers interpret results and link soil condition to yields and profitability. Where education was strong, farmers requested more tests, engaged more with advisors and implemented recommendations more consistently, while weaker sensitisation led to delays or avoidance, especially when registration and scheduling took too long or farmers were outside coverage areas.

Human support makes digital guidance actionable. SMS delivery was generally clear, but farmers often relied on agricultural experts and VBAs to interpret results and support action. Hands-on demonstrations were particularly important in low-tech settings and for older farmers, including rural women, where digital literacy and smartphone access were more limited. Extension actors improved credibility and onboarding and enabled follow up in the field, while performance-based incentives helped sustain outreach.

Adoption is limited by input affordability and local availability. Reported soil health improvements were strongest when farmers understood and applied the guidance, and uptake was highest when VBA support was tailored and consistent. However, implementation was often constrained by market realities. Recommended inputs could be expensive, unavailable locally, or located too far away to be practical, limiting the extent to which farmers could follow recommendations even when they wanted to act.

Crop2X

Country: Pakistan

Sector: Agriculture

Business model: B2C, B2B

Resilience capacity: Climate adaptation

Find out more: crop2x.com

Agriculture contributes around a quarter of Pakistan's GDP. Wheat, rice, sugarcane and cotton generate approximately $14 billion each year while using about 80% of national water resources, intensifying water scarcity.[47] Climate change adds further pressure through rising temperatures, shifting rainfall and more frequent extremes. At the same time, inefficient fertiliser use degrades soil health by affecting pH, pest pressures and soil organic matter, reducing productivity and increasing emissions. For many smallholder farmers, the scope to grow through land expansion, machinery or inputs is decreasing. Groundwater is overexploited, yields are harder to raise, and decisions are often made with limited data, contributing to inefficient water and fertiliser use.[48] The GSMA's research with smallholder farmers in Pakistan reflected this, with most reporting that changing climate conditions were already affecting their practices and water scarcity was becoming a growing concern.

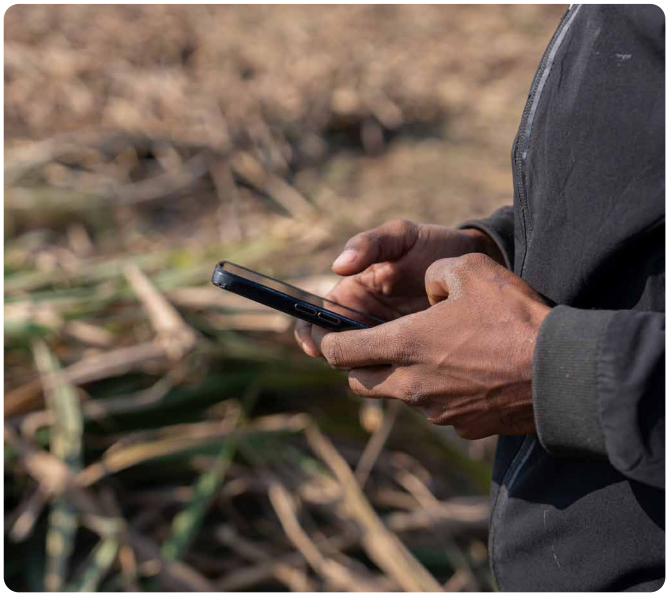
Crop2X is a Pakistan-based startup using precision agriculture to help farmers respond to these constraints. By combining IoT soil probes, satellite imagery and AI, Crop2X provides near real-time insights on soil moisture, soil health and crop risks, enabling more targeted decisions that can reduce costs and support climate resilient, sustainable practices.

With GSMA funding, Crop2X expanded its soil probe deployment and satellite-based monitoring, supporting farmers to use real-time data and actionable insights. The project onboarded 485 farmers, who received tailored summaries and recommendations based on soil probe readings and satellite indicators of crop health, fertiliser needs and water status.

PROJECT IMPACT

1.6K
people reached

485
farmers supported



How does the solution work?

→ Marketing

Crop2X drove uptake through trust-based rural engagement, combining on-the-ground field demonstrations and workshops with digital campaigns, and found that featuring real farmer stories and delivering simple, actionable advice in local languages increased engagement. This included targeted awareness activities intended to reach women farmers, despite cultural barriers to direct farm ownership.

47. Pakistan Bureau of Statistics (2024). 7th Agricultural Census of Pakistan.
48. World Bank (2021). Managing Groundwater Resources in Pakistan's Indus Basin.

→ Registration

The primary users are smallholder farmers who can join either through Crop2X's own advisory offering when engaged via field outreach, or through partner channels such as the integration of Crop2X's satellite advisory into Telenor Pakistan's Khushal Zamindar agri-platform, which provides an embedded route for Telenor's farming community to access the service.

→ Business model

Crop2X offered free introductory services to farmers, with a plan to move to subscription-based pricing for more predictable revenue. Income streams include subscriptions linked to IoT soil probe use and satellite advisory, rental access to portable soil probes (to reduce upfront costs for farmers), and B2B licensing of its satellite advisory API and related analytics to platforms such as mobile operators and other agribusinesses.

→ Mobile and digital technology features

The service uses IoT soil probes that transmit soil data over mobile internet, satellite imagery and a GIS-based crop monitoring approach, with AI models that automate crop classification and provide yield prediction. This enables Crop2X to remotely identify crops, anticipate risks such as water stress and pests, and deliver timely, colour-coded, farmer-friendly advisories through digital channels including WhatsApp, with voice assistance to support farmers with low literacy.

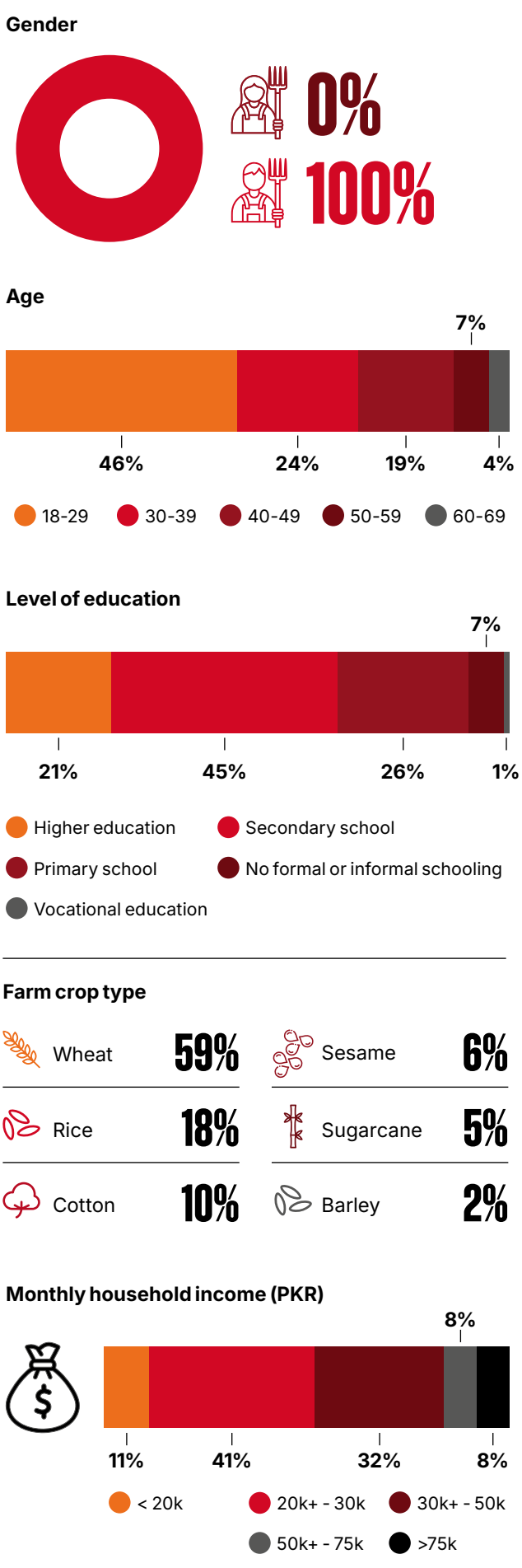
→ Offline, low-tech and no-tech features

Crop2X complements digital delivery with in-person field staff engagement and workshops that reinforce and explain advice. The project also highlighted the need to support low-connectivity contexts with simpler delivery options such as SMS or USSD-style approaches where real-time app usage is constrained.

Who uses Crop2x?

A typical user of Crop2x services is a 30-year-old male smallholder farmer managing a farm of less than two hectares, and who has completed secondary education. They are most likely to cultivate wheat as a primary crop, with a personal monthly income of approximately PKR 30,000 ($106).

Figure 6: Farmer profile*



*Of the farmers surveyed

Building climate resilience – what changed for farmers?

Improving knowledge and practices to support adaptation to climate stressors

Crop2X helped farmers move from intuition-based decisions to evidence-based field management, especially around soil and water stress. Most users had not previously tested their soil, and qualitative interviews suggest some were unaware that testing was possible. The service combined soil probes, satellite imagery and farmer updates to produce regular guidance that farmers could act on quickly, including where crops were stressed and which plots needed attention first. Farmers reported that this made it easier to adjust irrigation planning, input timing, and field management as rainfall and temperatures became less predictable, which is particularly relevant as many farmers had recently experienced water scarcity. Survey results reinforce this pathway, with almost all farmers reporting improved understanding of soil health and widespread implementation of recommended practice changes.

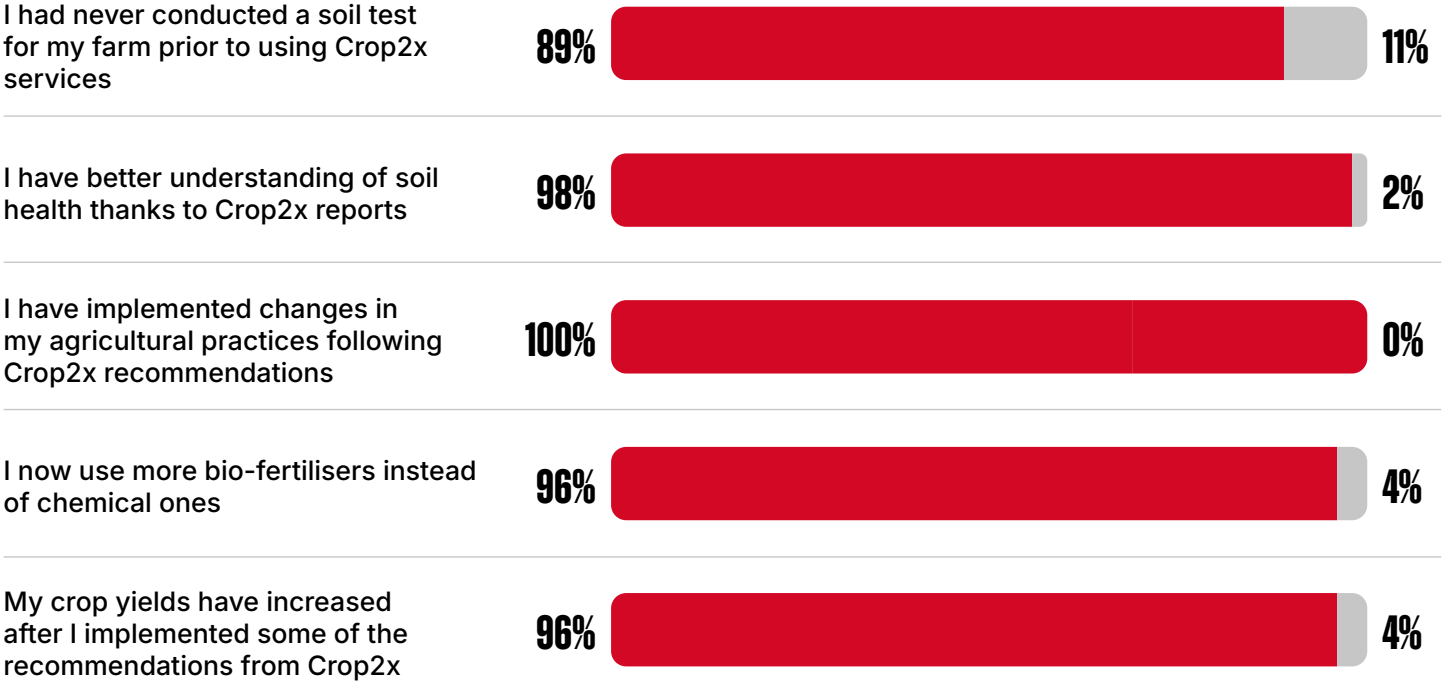
Improving environmental sustainability

Crop2X supported more sustainable use of inputs and water by helping farmers apply resources with greater precision, rather than treating the field as uniform. Farmers described using satellite imagery and field data to locate problem areas, and concentrating irrigation, fertiliser and spraying where it was needed, which reduced waste during periods of severe scarcity. The endline findings also point to a shift in input choices and application behaviour, including increased consideration of bio-fertilisers and reduced reliance on blanket chemical use, supported by a clearer understanding of pH and nutrient deficiencies. Farmers frequently linked these changes to improved cost efficiency through lower fertiliser consumption and, in some cases, reduced water use, while noting that input prices and water costs can still limit overall savings.

Farmer impact survey

Is the soil testing service helpful?

SHARE OF FARMERS RESPONDING YES OR NO



What did we learn?

Adoption improves when digital insights are paired with consistent human support and familiar channels. Farmers valued Crop2X's recommendations, but many initially struggled to interpret parts of the reports without additional explanation. Follow-up support from Crop2X agents, delivered by phone or in-person, was often necessary before farmers acted with confidence. This underlines how literacy gaps, limited technical confidence, and low familiarity with diagnostics can slow uptake without trusted guidance. It also reinforces the importance of delivering insights through channels farmers already use, especially WhatsApp, rather than assuming app-based engagement.

Diagnostic evidence and visualisation makes recommended changes easier to understand and implement. Where soil testing is uncommon, diagnostics can unlock behaviour change by making soil health measurable and specific. Crop2X training and reports introduced practical measures such as pH and nutrient deficiencies, helping farmers connect input choices to identifiable soil conditions. Satellite imagery strengthened this learning by helping farmers visualise field stress and focus action on the areas that needed attention most. Together, diagnostics and imagery reduced uncertainty, supported more targeted fertiliser and water decisions, and encouraged lower chemical use without requiring farmers to take risks blindly.

Perceived expertise can mask information gaps, so the value proposition must be repeatedly demonstrated in simple terms. Many farmers initially claimed they already understood soil health, but their understanding often relied on crop appearance, yields, and informal comparisons. Crop2X therefore needs to make the difference between intuition and measurement highly visible, using clear before and after examples, simple thresholds, and repeated reinforcement. This is particularly important when the service asks farmers to change inputs and water decisions that have been followed for years. Regular, practical demonstrations can help farmers recognise what is new, why it matters, and when it should change their behaviour.

Simple, transparent packaging supports trust and makes the service easier to sustain at scale. Farmers responded best when pricing, timing and service inclusion were easy to understand and communicated consistently. A straightforward seasonal fee linked to farm size can reduce confusion and help households plan for payments alongside other seasonal expenses. Clear communication about what the payment covers, for how long, and which features are optional can strengthen trust and reduce friction. This kind of clarity supports retention and makes long-term expansion more feasible without adding operational complexity.

> "The content is useful, but since we are not very literate, we cannot fully understand it. They visit every week or every 15 days, and sometimes they also call me on the phone to provide guidance. Whenever there is an issue, their representative personally explains it to me."
>
> *Crop2X farmer*

> "Crop2X showed me how to use the fertilisers and explained the importance of reducing chemical use, as overuse was harming my soil. I followed their advice and significantly cut my chemicals use."
>
> *Crop2X farmer*

Farm to Feed

Country: Kenya

Sector: Agriculture

Business model: B2C, B2B

Resilience capacity: Climate adaptation

Find out more: farmtofeedkenya.com

In Sub-Saharan Africa, half of the fruits and vegetables produced do not reach consumers, leading to financial losses for farmers and higher food prices. In Kenya, smallholder farmers are particularly affected as their produce is prone to quality issues due to extreme weather and limited access to affordable, high-quality agricultural inputs. This often results in produce being rejected for its appearance or quality, causing farmers to abandon their crops. Farm to Feed is a Kenyan-based startup tackling food loss and food insecurity through a tech-enabled B2B platform. By creating a market for imperfect or surplus produce that would otherwise go to waste, they provide farmers with additional income and offer nutritious food to consumers at affordable prices. Farm to Feed's circular economy model directly addresses environmental impact and supply chain inefficiencies, fostering a more resilient and sustainable agricultural ecosystem in East Africa.

Farm to Feed received funding from the GSMA to develop a farmer-facing app and USSD platform so that farmers could sell imperfect fruit and vegetables, rescuing them from becoming food waste and thus improving environmental sustainability, reducing farmer income loss, and improving local food security. The GSMA grant also helped Farm to Feed develop an e-commerce platform where 124 businesses signed up to offtake imperfect and surplus produce from Farm to Feed registered farmers.

PROJECT IMPACT

64K
people reached

145
farmers supported

124
B2B users of e-commerce platform

1.9K
kilograms of rescue grade food saved

How does the solution work?

→ Marketing

Farm to Feed used SMS, radio and in-person outreach, backed by practical training sessions and demo-style engagement. Buyer growth was supported through B2B-facing events and a new e-commerce catalogue experience.

→ Registration

The service has two main user groups; smallholder farmers supplying imperfect or surplus produce, and B2B buyers such as retailers, institutions and processors. Farmers can

sign up and engage via a Farmer App or USSD channel, although many preferred a relationship-led journey where they phone Farm to Feed staff directly, while B2B buyers register and transact through the B2B e-commerce platform to browse the catalogue and place orders.

→ Business model

The startup generates revenue by selling rescued produce to B2B customers and by charging for tech-enabled logistics services that help buyers aggregate supply efficiently, supported by a dynamic pricing approach that reflects supply, demand and quality grades. Farm to Feed also uses subscription-based SMS communication tools to engage farmers and buyers at scale, strengthening repeat trade and operational efficiency. The startup piloted value-added produce such as fruit concentrates, powders and peeled garlic to generate income in different product lines.

→ Mobile and digital technology features

Farm to Feed developed a Farmer App and USSD for farmer engagement to acquire produce, and a B2B e-commerce platform that improved online ordering and catalogue transparency. They also used digital orders and price alerts to support planning, built commercial dashboards and impact tools such as a carbon calculator, and provided real-time weather forecasting to farmers via SMS, with further digital improvements shaped by research including simpler user journeys, language expansion and auto-reminders.

→ Offline, low-tech and no-tech features

The model uses various low-tech and offline operations, including farmers calling staff to sell produce, outreach via SMS and radio, and in-person training that promotes climate-smart practices such as mulching, crop rotation and soil conservation. Farm to Feed relies on physical aggregation and logistics, and recognises the need to make non-smartphone access reliable where USSD failures or a lack of offline app functionality can block participation, especially for women and farmers with lower digital literacy.

Who uses Farm to Feed?

The GSMA conducted a qualitative study with Farm to Feed service users, from which we were able to establish that a typical user of Farm to Feed services is a 45-year-old smallholder farmer managing a farm of less than two hectares and who has completed at least primary school education or higher. They are most likely to cultivate leafy and brassica greens or roots and tubers as a primary crop, with a personal monthly income between KES 25,000 and 35,000 ($192-269), consistent with the national average income.[49]

Building climate resilience – what changed for farmers?

Improving knowledge and practices to support adaptation to climate stressors

Farm to Feed improved farmers' ability to plan and adjust production under uncertain conditions by giving clearer visibility of demand. Around half of farmers now track orders through the app and report feeling more in control of their farming activities. Farmers who are not using the app still receive orders and pricing information through field agents, supporting timely decision-making. Many farmers reported changes in how they farm, including dividing land, staggering planting, and diversifying crops to manage risk, maintain yields, and sell produce more consistently across the year.

For buyers, Farm to Feed improved procurement planning and day-to-day purchasing practices through a clearer, more flexible ordering process. Several buyers valued the online platform for easy order confirmation, flexibility, and access to different grades, which helped them adjust menus and purchasing around what is locally seasonal and available.

Improving financial resilience and climate shock absorption

Farm to Feed strengthened income security by providing a more reliable route to market and reducing transaction risk. Farmers described Farm to Feed as a primary client and valued weight-based rates as more transparent than piece-based

49. Kenya National Bureau of Statistics (2025). 2025 Economic Survey.

pricing from middlemen. Clear order confirmations and consistent mobile payments made selling feel simpler and safer, and several farmers reported increased motivation because they expected less produce to go to waste. However, some farmers noted that sales volumes can be small or infrequent, which limits how far Farm to Feed can stabilise income across seasons.

Farm to Feed reduced cost and supply risk for buyers who previously faced inconsistency, quality issues, and price volatility across fragmented suppliers. Some buyers reported Farm to Feed was cheaper for large volumes, and many valued the reliability and responsiveness when issues arose, which helped them maintain continuity of meals and operations.

Improving environmental sustainability

Farm to Feed reduced on-farm food loss by purchasing imperfect and rescue-grade produce that would otherwise have limited value. Many farmers reported selling undersized or non-aesthetic crops through Farm to Feed, turning what was previously discarded or animal feed into income. Farmers also noted that Farm to Feed's grading system and price differentiation enabled sales across multiple quality grades, rather than only the highest grade being accepted. Despite this, some farmers still reported having leftovers when orders did not cover their full harvest.

Farm to Feed enabled buyers to purchase rescue-grade produce that they had not previously sourced, helping reduce food waste while still meeting nutrition and quality requirements. Buyers reported increased comfort using rescue grades when safety and freshness were assured, and some explicitly linked this sourcing model to progress against organisational sustainability goals.

What did we learn?

Transparent grading and price incentives can unlock rescue-grade demand, but supply variability affects margins and requires product diversification. Buyers were willing to purchase rescue-grade produce because they perceived minimal differences in nutritional value compared with higher grades, and because pricing was designed to be lower than market alternatives. However, imperfect produce is inherently variable in aesthetics, quality and volume, which tightened Farm to Feed's margins. To protect profitability while scaling impact, Farm to Feed strengthened a domestic and export strategy that converts imperfect produce into higher-value, shelf-stable formats such as fruit concentrates and powders.

Trust, access and logistics shaped adoption as much as the app, and logistics remained a binding constraint. Many farmers had not previously sold produce online and some were concerned about fraud, therefore Farm to Feed's trusted agents and transparent processes were central to confidence and participation. Even with the app available, several farmers still relied on agents or were blocked by connectivity and handset challenges, reinforcing the need for practical digital support and more offline-friendly features. Farmers also asked for more frequent collections and nearer aggregation points, which suggests that scaling impact will require investment in decentralised hubs and improved routing, as well as platform improvements.

Market norms change gradually, so rescue-grade supply grows when farmers can test the channel and build confidence over time. Creating a buyer for rescue-grade produce does not immediately reset longstanding incentives that reward perfect appearance. While many farmers began selling under-sized or non-aesthetic crops through Farm to Feed, a meaningful minority still preferred to supply only Grade I produce as a risk management strategy. This reflects concerns about income certainty, product acceptance consistency, and reputation with buyers. Several farmers indicated they are willing to expand into rescue grades once they have tested the process and gained confidence that acceptance and pricing remain reliable.

Continuous engagement with farmers and buyers created the feedback loops needed for iteration and sustained uptake. Regular farmer trainings and structured buyer engagement forums provided a reliable channel for feedback on usability, pricing, logistics and grade preferences. This ongoing dialogue supported practical iteration, strengthened trust, and improved the likelihood of adoption by both farmers and buyers as the service expanded.


Minute Maid

HydroNeo

Country: Thailand

Sector: Aquaculture and fisheries

Business model: B2C

Resilience capacity: Climate adaptation

Find out more: hydroneo.net

Thailand's shrimp industry is a significant pillar of its fishing and aquaculture economy, yet production has declined from 600,000 metric tonnes in 2011 to 270,000 in 2022, driven largely by persistent disease outbreaks like Early Mortality Syndrome (EMS).[50] Climate change shocks are exacerbating this decline as rising water temperatures induce thermal stress, while erratic rainfall causes sudden salinity shifts and nutrient-driven algae blooms, leading to increased shrimp mortality. HydroNeo specialises in IoT-based smart farm management systems for the aquaculture industry. Focused primarily on shrimp and fish farming in Southeast Asia, HydroNeo provides real-time water quality monitoring and automated aeration control. Their technology helps farmers reduce energy costs, minimise mortality risks, and optimise feed efficiency, driving the transition towards profitable and sustainable precision aquaculture.

HydroNeo was awarded a GSMA Innovation Fund grant to develop a smart-farming app to accompany its IoT smart farm management system for Thai shrimp farmers. The funding helped HydroNeo to develop specific features to help farmers detect disease and monitor shrimp health, access shrimp market price and climate data, and to better manage farm finances.

How does the solution work?

→ Marketing

For HydroNeo, community-based engagement was more effective than digital advertising when introducing the benefits of IoT and digital technology to shrimp farmers, so it prioritised roadshows, field demonstrations and farmer club collaborations that let shrimp farmers see the technology in action. This was supported by strengthened digital communications such as improved website SEO and more consistent messaging to build awareness of the Digital Farm App.

→ Registration

The core users are small-scale shrimp farmers in Thailand, with adoption typically higher among large-scale farmers who are more familiar with using technology in their operations. Farmers can download the HydroNeo Digital Farm App via Google Play, start with free basic features, and then activate additional

PROJECT IMPACT

3.5K
people reached

1K
farmers supported

4.8K
tonnes of shrimp harvested through sustainable practices

50. Bangkok Post (2025). Shrimp exports forecast to claw back next year. (Accessed 4 March 2026)

capability through affordable in-app purchases, with hands-on training and onboarding support to aid farmers in moving from traditional manual practices to regular app use.

→ Business model

HydroNeo shifted from a hardware and cloud service sales model to a subscription-based model, enabled by a more compact plug-and-play hardware version and a standalone premium application. This created more predictable recurring revenue, lowering entry costs for farmers and setting up future tiered subscriptions that match feature access and pond scale to different customer segments.

→ Mobile and digital technology features

The Digital Farm App brings together IoT-connected farm monitoring and mobile-enabled decision support, including regional climate and weather data and alerts, disease reporting and detection, shrimp size measurement and growth analytics, a domestic shrimp market price index with trends and predictions, farm financial overview tools, and market demand insights, all designed to help farmers respond faster to climate risks such as heat, disease outbreaks and algae blooms.

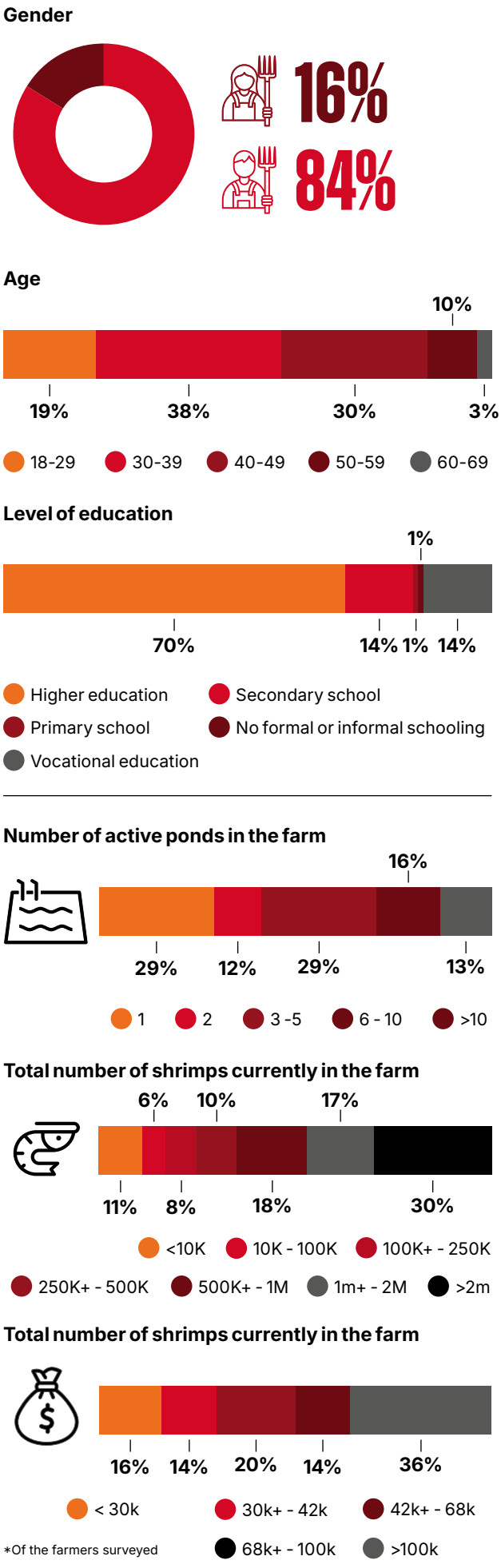
→ Offline, low-tech and no-tech features

The service relies on offline trust-building and practical support, including field demos, group trainings and direct farmer assistance. The physical IoT hardware remains a key part of the value proposition, with sensors that can automate aerator operation so they run only when needed, delivering energy savings and giving farmers confidence to adopt more advanced digital features over time rather than relying solely on manual observation.

Who uses HydroNeo?

A typical HydroNeo user is a 38-year-old male shrimp farmer with higher education, managing three to five ponds and earning around THB 42,000 ($1,298) per month. Survey findings suggest this group is more educated than the wider farming population, as only six per cent of Thai farmers have completed higher education, compared with 70% of surveyed shrimp farmers.[51] This profile reflects shrimp farming's higher capital intensity and technical complexity, which favours wealthier, more skilled operators.

Figure 7: Farmer profile*



51. FAO (2023). 2023 Thailand Agricultural Census.

Building climate resilience - what changed for farmers?

Improving knowledge and practices to support adaptation to climate stressors

HydroNeo strengthened farmers' ability to adapt day-to-day by making pond conditions more visible and easier to act on, especially when weather and water quality shift quickly. Farmers described using the system to move from periodic manual checks to more responsive management, adjusting feeding, aeration and routine pond practices when real-time indicators signalled risk. This is reflected in the survey, where 76% said they used real-time metrics to adapt their farming practices, and 72% reported increased pond productivity since using HydroNeo. In qualitative interviews, some farmers reported reduced shrimp mortality, linking improvements to faster response times and more precise management enabled by the IoT system. Farmers also tended to attribute benefits to the broader HydroNeo ecosystem, where hardware alerts and hands-on support make the insights actionable, rather than to the app alone.

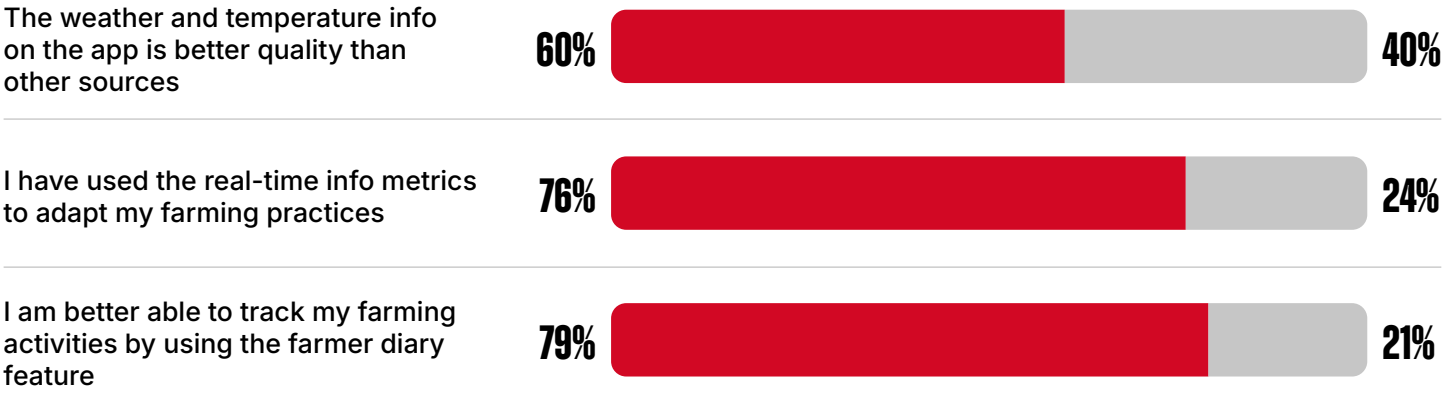
Improving environmental sustainability

HydroNeo's environmental contribution is most evident through waste reduction and efficiency gains from tighter pond management, rather than farmers monitoring a wide set of environmental indicators. Farmers linked sustainability to avoiding losses, using inputs more efficiently, and maintaining stable pond conditions that prevent spoilage and mortality. Survey results support this, with 69% reporting that they adopted more sustainable practices after using HydroNeo, and 60% reporting reduced wasted production. Qualitative feedback suggests farmers prioritised practical, reliable information and were less likely to engage with app metrics they perceived as too general or not sufficiently precise for daily decisions. This helps explain why sustainability benefits were strongest where features aligned with routine management needs and produced visible improvements that farmers could quickly recognise.

Farmer impact survey

Is the HydroNeo app helpful?

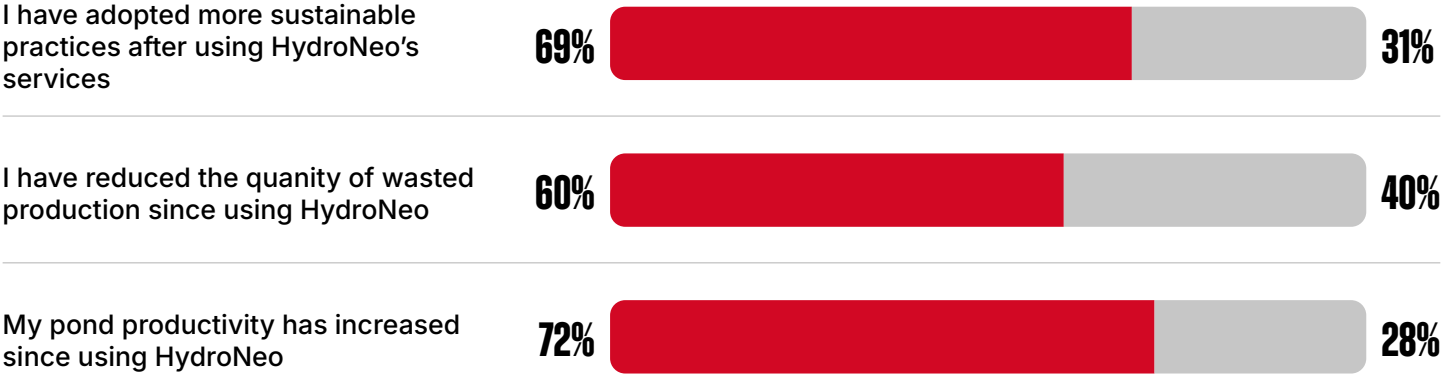
SHARE OF FARMERS RESPONDING YES OR NO



Farmer impact survey

Overall impact of HydroNeo's service package

SHARE OF FARMERS RESPONDING YES OR NO



What did we learn?

Early uptake skews towards larger, better-resourced farms, which can narrow reach. Interviews indicate HydroNeo users were typically more affluent and tech-receptive than the average Thai farmer, reflecting shrimp farming's capital intensity and downside risk. Multi-pond operators adopted first because they could spread costs and observe returns quickly, while smaller or single-pond farmers were more cautious about value for money and required clearer proof, lower-cost entry routes, and more hands-on support.

IoT alerts earn trust because they are immediately actionable, while some app features hold less obvious relevance to routine farming. Farmers consistently valued real-time monitoring and alerts that supported quick interventions on changing pond conditions. By contrast, non-IoT features were used less when benefits were not obvious upfront, when they felt impractical, or when they did not fit established workflows, which limited engagement beyond the core hardware experience.

Across modules, farmers consistently prioritise information that feels practical, reliable, and directly useful for daily pond decisions, rather than tracking a wide set of environmental indicators. Use patterns suggest that some newer features still need time, visibility, and clearer positioning to become part of routine practice, especially for metrics that farmers do not currently monitor day-to-day. Weather remains a high-value input, and many farmers complement HydroNeo with other trusted sources to cross-check local forecasts. Market information followed a similar pattern, with many farmers continuing to rely on wholesalers, online communities, and official guidance for timely price signals and advice, reflecting established decision-making habits. These behaviours point to an opportunity to strengthen impact by focusing the app experience on fewer, higher-utility signals, and by ensuring that market and forecast features align closely with what farmers recognise as actionable and locally relevant.

High-trust, data-dependent features expose a hard dependency on dataset quality and incentives for participation. Disease Radar uptake remained low, as farmers were unsure about alert reliability and concerned about reputational or privacy risks associated with disease reporting, even when anonymity was offered. External datasets and outsourced classification also fell short of HydroNeo's quality requirements, pushing the team to collect images directly from farms and draw on additional technical support to improve model performance. This increased operational demands and extended timelines, but strengthened control over data relevance and accuracy. Similar trust and incentive dynamics surfaced in discussions with shrimp processors, where reluctance to enter formal agreements slowed progress when the perceived benefits were not yet clear.

InQube

The Sundarbans mangrove region in West Bengal, India, faces severe ecological threats from climate change, salinity intrusion, and erosion. Some of the deadliest tropical cyclones globally have struck the Bay of Bengal, repeatedly damaging crops and assets, and pushing small and marginal farmers into a deepening farming crisis marked by falling yields, rising input costs, and increasing uncertainty. Farmers need timely, localised information and support to adapt their practices, manage risk, and maintain access to markets and finance.

InQube is an agriculture-focused startup founded in India that seeks to transform agricultural value chains by integrating real-time data with advisory and financial services for farmers, providing vital access to credit, inputs, markets and information. InQube received funding from the GSMA to develop and deploy its app-based platform to support farmers and cooperatives in rural coastal India with climate-resilient and regenerative agricultural practices, while also working to restore mangrove forests through a community-centred tree-planting initiative across 10 hectares in the Sundarbans.

The funding enabled InQube to develop features to help farmers with diary keeping, problem-solving support, and digital training content on good farming and regenerative agriculture practices, alongside an input marketplace and localised weather forecasting. InQube also supported the piloting of IoT devices designed to help farmers track activities and strengthen decision-making at farm level.

How does the solution work?

→ Marketing

InQube combined a strong field training programme in the Sundarbans region with a profile-raising campaign that leveraged social media.

→ Registration

The service is designed for small-scale farmers in climate-vulnerable areas, with platform use also extending to farm aggregators and Farmer Producer Companies that need farm-to-market integration. Users are introduced through structured workshops

Country: India

Sector: Agriculture

Business model: B2C

Resilience capacity: Climate adaptation

Find out more: inqube.biz

PROJECT IMPACT

127K
people reached

31.8K
farmers supported

5K
mangrove saplings in the Sundarbans

$3.6M
in additional investment

and follow-up support, then onboarded onto the GreenQube app-based platform for farm decision support and supply chain participation, while Farmer Producer Companies list products and begin to trade through the B2B trading platform.

→ Business model

The core commercial model is SaaS, with user-based fees paid by farm sector aggregators and value chain enterprises. InQube is also evolving the platform with dMRV capability for nature-based carbon credits integration, where pricing is expected to blend a minimum user-based fee with a recurring share of carbon finance revenue, creating an additional longer term revenue line as carbon projects mature.

→ Mobile and digital technology features

The project piloted 50 IoT devices in remote areas and used satellite analytics to establish validated baselines for carbon offset activity in mangroves and paddy farming, strengthening measurement and validation for future carbon finance projects. The core feature is a digital app-based platform.

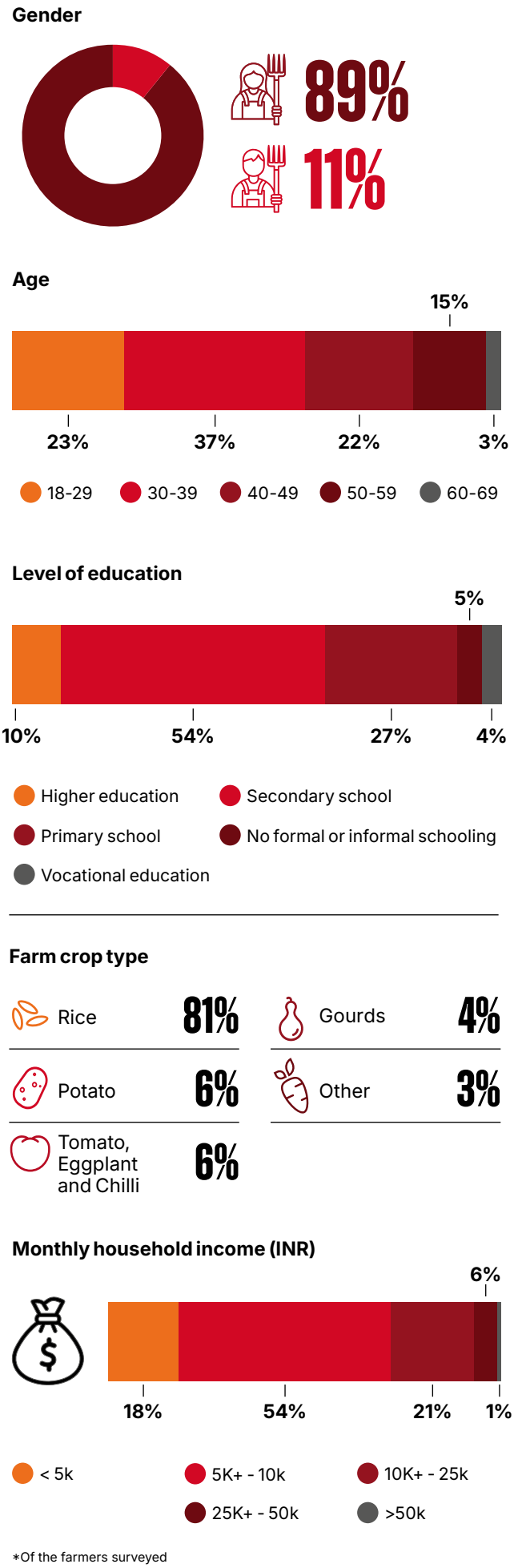
→ Offline, low-tech and no-tech features

Delivery relied heavily on offline engagement, including in-person workshops, training videos used in community settings and tangible climate actions, including planting 5,000 mangrove saplings.

Who uses InQube?

A typical InQube user is a 35-year-old female farmer with secondary education, managing a farm smaller than 0.5 hectares, and earning between INR 5,000-10,000 ($57-115). The average farmer in the Sundarbans is 52 years old,[52] significantly older than the average age of 38 years among surveyed farmers. This is likely due to GreenQube being used by younger and more active members of the household. Conversely, only 68% of farmers surveyed completed lower secondary education, compared to 86% of Indians.[53] This disparity can be linked to the fact that the target area is a very remote rural district in India.

Figure 8: Farmer profile*



*Of the farmers surveyed

52. Dutta, S. et al. (2019). Socio Economic Scenario of the Farming Community Living in Climate Sensitive Indian Sundarbans. Int. J. Curr. Microbiol. App. Sci. 3156-3164.

53. UNESCO Institute for Statistics (2019). India SDG 4 Data.

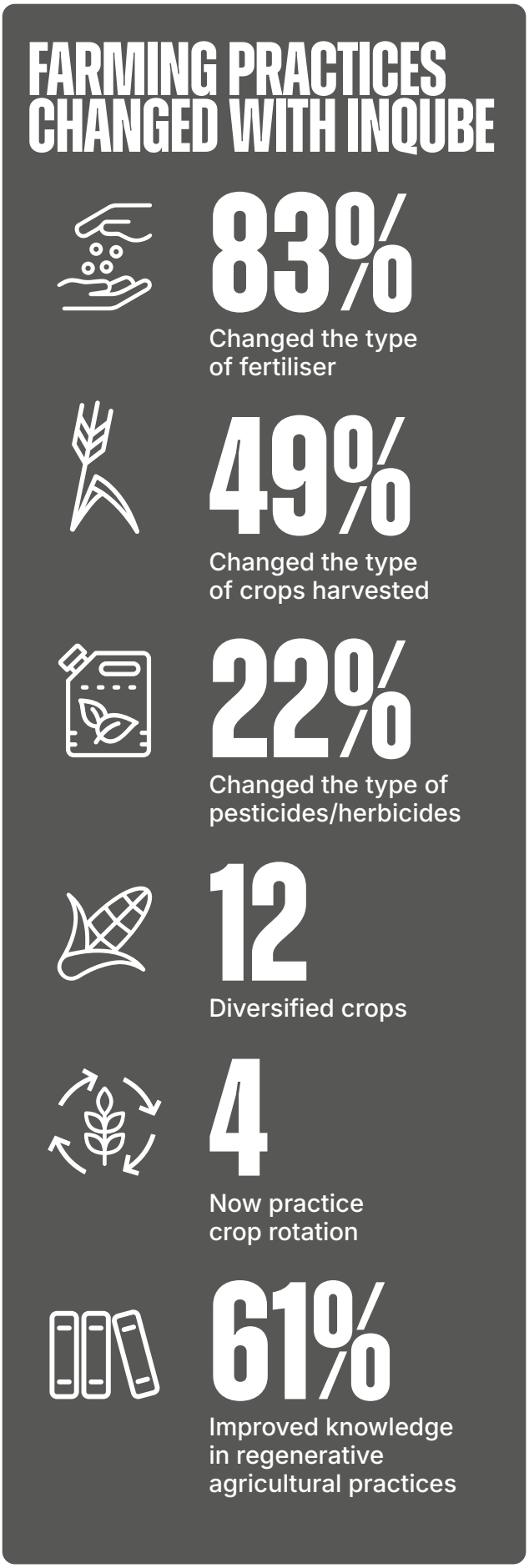
Building climate resilience - what changed for farmers?

Improving knowledge and practices to support adaptation to climate stressors

GreenQube's strongest adaptation pathway combined locally relevant training with simple tools that helped farmers plan and act with more confidence. Survey results suggest the training translated into both learning and practice change, with 72% learning new regenerative farming practices and 79% reporting adoption of more sustainable practices after the training. Farmers described the videos as practical because they reflected local crops and conditions, and often featured advice from other farmers, which increased confidence to try techniques such as mulching, organic manure use, and more diverse cropping. App features also supported follow-through by making decisions easier to manage in real time. The problem-solving feature was used by 69% of farmers, and 83% of those users said it helped them handle farm issues more independently, reinforcing timely action when conditions change. Together, the evidence points to a shift from relying mainly on informal advice towards a more structured mix of peer-informed learning and decision support that helps farmers respond to weather variability and production shocks.

Improving environmental sustainability

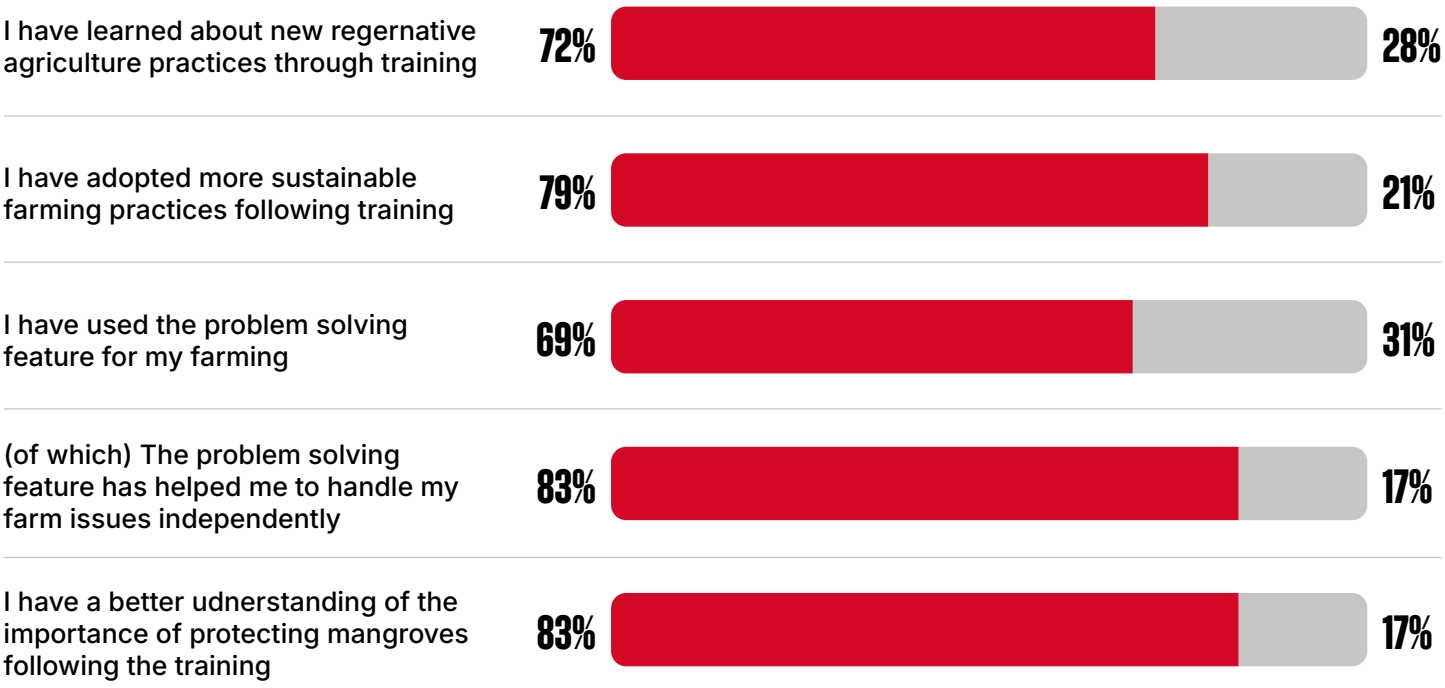
Environmental outcomes were driven primarily through stronger understanding of mangrove protection and early participation in restoration activities. When surveyed, 83% of farmers said the training helped them understand the importance of protecting mangroves, and qualitative feedback suggests this became more specific over time, including a clearer understanding of how mangroves reduce storm impacts, limit saline intrusion, and protect coasts. Some participants described hands-on restoration roles such as preparing seedlings, planting, watering saplings, and protecting sites from damage, often through collective decisions about which species to plant. A smaller subset also used the GreenCube app for mangrove information and QR-based plant tracking, although some found data-upload steps unclear, limiting consistent digital monitoring. Farmers also reported observing increased local mangrove coverage and a wider community awareness of protection, while noting that benefits remain early-stage because mangroves are not yet fully grown and pressures such as grazing still affect plantation sites.



Farmer impact survey

Have farmers changed their farming practices?

SHARE OF FARMERS RESPONDING YES OR NO



What did we learn?

Access to timely, tailored advice can be a practical driver of adaptation when it builds farmer confidence to act. The problem-solving feature, which connected farmers to agricultural experts and enabled image sharing, was reported as highly useful and well-suited to their specific issues by 85% of farmers. This was linked to faster resolution of problems and greater confidence to respond independently, which reinforces the value of decision support that arrives at the moment choices are made.

Locally grounded training helps translate knowledge into uptake, particularly when content reflects farmers' real conditions. Survey results indicate that 72% learned new regenerative practices through training, and 79% reported adopting more sustainable farming practices afterwards. In qualitative feedback, farmers emphasised that examples featuring local crops and peer farmers made recommendations feel credible and achievable, which increased willingness to try techniques such as mulching, organic manure use and more diverse cropping.

Onboarding and reinforcement remain central to consistent use, even where smartphone access exists. Farmers were more likely to use the service when introduction and follow-up were delivered through trusted local structures, in local languages, and with practical, repeated support. Some farmers did not discover certain functions or feel confident using them without assistance, which suggests that training, prompts and user support should be planned and budgeted as core delivery inputs rather than treated as a one-off launch activity.

Environmental engagement strengthens when mangrove awareness is paired with hands-on participation and simple monitoring workflows. Farmers reported clearer understanding of how mangroves reduce storm impacts and saline intrusion, and some described roles in seedling preparation, planting, watering, and protecting sites through collective decisions. However, digital tracking adoption was uneven where processes felt unclear, and ongoing pressures such as grazing continued to threaten plantation sites, reinforcing the need for low-friction tools and practical site protection measures while restoration benefits mature.

Monsoon Tea Company

Northern Thailand is grappling with a severe climate-biodiversity crisis, having lost over 20% of its forest cover to monoculture expansion between 1973 and 2020.[54] This degradation fuels habitat destruction, erratic monsoons and intense heatwaves. Such shifts devastate local ecosystems and threaten the traditional livelihoods of upland communities who depend on forest health for survival and economic resilience. Monsoon Tea is a Thailand-based social enterprise dedicated to protecting Thailand's biodiversity through its forest-friendly tea model. By sourcing wild tea from indigenous trees in the northern Thai region of Chiang Mai, the company prevents deforestation and preserves mountain ecosystems. Monsoon Tea empowers local communities while offering premium, sustainable alternatives to traditional monoculture plantation tea. Monsoon Tea Company, supported by a GSMA Innovation Fund grant, has pioneered the use of IoT bioacoustics sensors and mobile technology to incentivise forest-friendly tea farming in Northern Thailand. By developing a dedicated web app and biodiversity measurement process, the company now provides farmers with premium payments based on verified positive ecological impacts.

Country: Thailand

Sector: Agriculture

Business model: B2C

Resilience capacity: Climate adaptation

Find out more: monsoontea.co.th

PROJECT IMPACT

3.5K
people reached

250
farmers supported

43K
Kilograms of tea purchased from farms using the app

How does the solution work?

→ Marketing

Monsoon Tea Company promoted its forest-grown tea through biodiversity and community livelihood storytelling, supported by a consumer event on traceability. Monsoon Tea Company also improved its e-commerce journey to make it easier for customers to buy products linked to measurable biodiversity outcomes and verified sustainability claims.

→ Registration

The primary users are minority upland tea farmers in Northern Thailand, and by association, tea factories, tea pickers and intermediaries. Farmers are onboarded through in-person training, and use the Monsoon Tea farmer app to support

54. UNESCAP (2024). Asia-Pacific Digital Transformation Report 2024.

biodiversity traceability and scoring, while Monsoon Tea Company staff manage participation through an internal web app.

→ Business model

Revenue comes mainly from selling forest-friendly tea through direct retail, online sales, tea experiences linked to tourism, and growing business-to-business original equipment manufacturing and wholesale supply. Traceability helps secure premium buyers, while farmers receive bonuses linked to biodiversity scores.

→ Mobile and digital technology features

The solution combines a farmer biodiversity app with an internal web platform and a biodiversity traceability system. IoT bioacoustics sensors record bird and insect sounds, which are converted into biodiversity scores to guide conservation actions and reward decisions.

→ Offline, low-tech and no-tech features

Delivery relies on fieldwork in remote mountain areas, including sensor installation, maintenance and troubleshooting. Adoption is built through in-person biodiversity and gender training, plus ongoing community engagement and support from tea factories, especially where farmers have limited smartphone confidence and extreme weather disrupts routines.

Who uses Monsoon Tea Company?

The typical farmer surveyed is 43 years old and completed secondary education, manages a tea farm that is less than two hectares in size, and earns around or below THB 5,000 monthly ($154).

Building climate resilience – what changed for farmers?

Improving knowledge and practices to support adaptation to climate stressors

Monsoon Tea Company's training programmes strengthened farmers' understanding of biodiversity, climate risks and gender equality, and supported practical day-to-day shifts in farm management. Farmers described reducing or stopping herbicide use, making more informed pruning decisions, and improving watering and waste management. These changes reflect a move towards more climate-resilient and biodiversity-friendly practices that can reduce input reliance and strengthen longer-term farm health. The trainings also reinforced community engagement, which helped sustain attention to good practice in remote upland contexts where formal extension support is often limited.

Improving financial resilience and climate shock absorption

Financial outcomes were shaped mainly by the trading structure, as most farmers sell tea indirectly through long-established local factories where price remains the primary driver. One factory now sells around half its tea to Monsoon Tea, while the other sells up to 90%, suggesting strong downstream demand for this market channel, but also indicating that household-level benefits depend on how intermediaries pass value through. In one community, farmers reported higher incomes when a community enterprise was created to buy fresh leaf from members, process it, and sell exclusively to Monsoon Tea. That shift strengthened farmers' bargaining position by raising local purchase prices and prompting factories and middlemen to improve their offers, while attribution remains linked to intermediary pricing decisions and wider market dynamics.

Improving environmental sustainability

Environmental outcomes were most evident through the reinforcement of forest-friendly tea production and biodiversity stewardship in upland landscapes. Training helped farmers link day-to-day practices to wider ecosystem health, including how input use and land management choices affect surrounding forest systems. By strengthening knowledge and community engagement around biodiversity, the programme supported behaviours that protect forest cover and the ecological conditions that forest tea depends on, even where the baseline for forest-friendly practice was already relatively high.

What did we learn?

High baseline contexts shift what progress looks like, so value is often protecting and sustaining good practice over time. In Pa Pae and Doi Pu Muen, forest tea is already grown under tree cover with longstanding restrictions on chemicals, hunting and forest clearance, reinforced by protected-area rules. In this setting, training strengthened ecological understanding and helped reinforce practices that were already biodiversity friendly, rather than needing to drive large visible changes. This also highlights the importance of aligning incentives with context, since biodiversity bonuses are most motivating when they are timed to feel immediate and tangible for households.

Value and decision-making often sit upstream in established tea value chains, so intermediaries need to be engaged as delivery partners and incentive carriers. Most farmers sold through factories or the community enterprise rather than directly to Monsoon Tea, and awareness of end buyers can be limited in legacy supply structures. This can soften the strength of feedback loops unless factories and community enterprises are actively embedded in communications, training reinforcement, and any reward mechanism that reaches households.

Biodiversity measurement and digital traceability work best when designed for local constraints and implemented on realistic timelines. Measurement and traceability frameworks were strongest when built with local partners who could translate needs into feasible specifications that fit language, connectivity and adoption patterns. Baseline design and data governance support also improved indicator reliability and usability. Incentive payments benefit from alignment with harvest cycles, because predictable timing supports trust and sustained participation.

Market pull is strongest for clear, credible sustainability claims, so verification should be translated into simple buyer-facing value. Four of five Monsoon Tea buyers interviewed said Monsoon Tea's sustainability attributes materially influenced their purchasing decision, and the fifth viewed them positively even though they had not noticed them initially. Awareness of the biodiversity measurement and traceability programme was low, which suggests that buyers respond first to simple, well-evidenced claims unless the verification tools are clearly explained. When customers were introduced to the app, several expressed interest in sharing trusted information with their own customers and strengthening downstream credibility.

Pricepally

Climate change is disrupting agricultural productivity in Nigeria through drought, erratic rains, flooding, rising temperatures, and growing aridity. These shocks lower yields and quality, weaken farmer incomes, and tighten food supply. High post-harvest losses and inefficient distribution compound the problem, as produce is spoiled or sold cheaply due to poor logistics and weak market links. Consumers feel the effects through higher food prices and reduced access to affordable, nutritious food. Floods have become more severe as a result of more frequent intense rainfall events, and the destruction of around 700,000 hectares of farmland in 2025 has further worsened food insecurity.

Pricepally is a Nigerian startup tackling these inefficiencies to reduce waste and improve food affordability. Using a group-buying model, Pricepally connects consumers directly with farmers and wholesalers, reducing reliance on intermediaries and strengthening traceability. Research found that nearly all target users had experienced post-harvest losses in recent years, driven by a mix of avoidable production decisions and mismatches between supply and demand. With support from the GSMA Innovation Fund, Pricepally developed an online grocery platform that has helped over 500 farmers make more informed decisions about what to plant and in what quantities. Clearer demand signals have reduced unsold produce and improved income stability through more reliable routes to market.

Country: Nigeria

Sector: Agriculture

Business model: B2C

Resilience capacity: Climate adaptation

Find out more: pricepally.com

PROJECT IMPACT

26.7K
people reached

527
farmers supported

8.7K
low-income customers purchasing food through Pricepally

How does the solution work?

→ Marketing

Pricepally grew adoption in Nigeria through roadshows and digital campaigns. Messaging highlighted affordable and predictable access to nutritious food through bulk buying and flexible delivery. Targeted business-to-business outreach focused on attracting repeat higher-volume buyers.

→ Registration

Users include low-income households and urban bulk buyers purchasing food, as well as farmers and suppliers providing produce. Consumers register through the e-commerce site and mobile app. Farmers are onboarded through field engagement led by agents, with additional support for older farmers and those with limited smartphone access.

→ Business model

Pricepally earns revenue from food sales and logistics fulfilment across both B2C and B2B channels. Margins are improved through aggregation, tighter inventory control, and efficient last-mile delivery, while growing higher-value institutional accounts. Farmers receive confirmed harvest orders via field agents or direct contact and are paid by bank transfer once deliveries are verified. Consumers order via the app, with produce sourced from partner farmers and wholesale markets, and delivered to homes or agreed drop-off points.

→ Mobile and digital technology features

Pricepally upgraded its consumer app and e-commerce platform and launched an Android operations app for field, warehouse and delivery teams. It introduced automated inventory management linked to its ERP, added an AI chatbot for customer support, and built dashboards and traceability tools to improve stock visibility and reduce waste. Demand forecasting helps estimate monthly needs, enabling pre-arranged harvest orders so supply matches expected demand and reduces sell-after-harvest uncertainty.

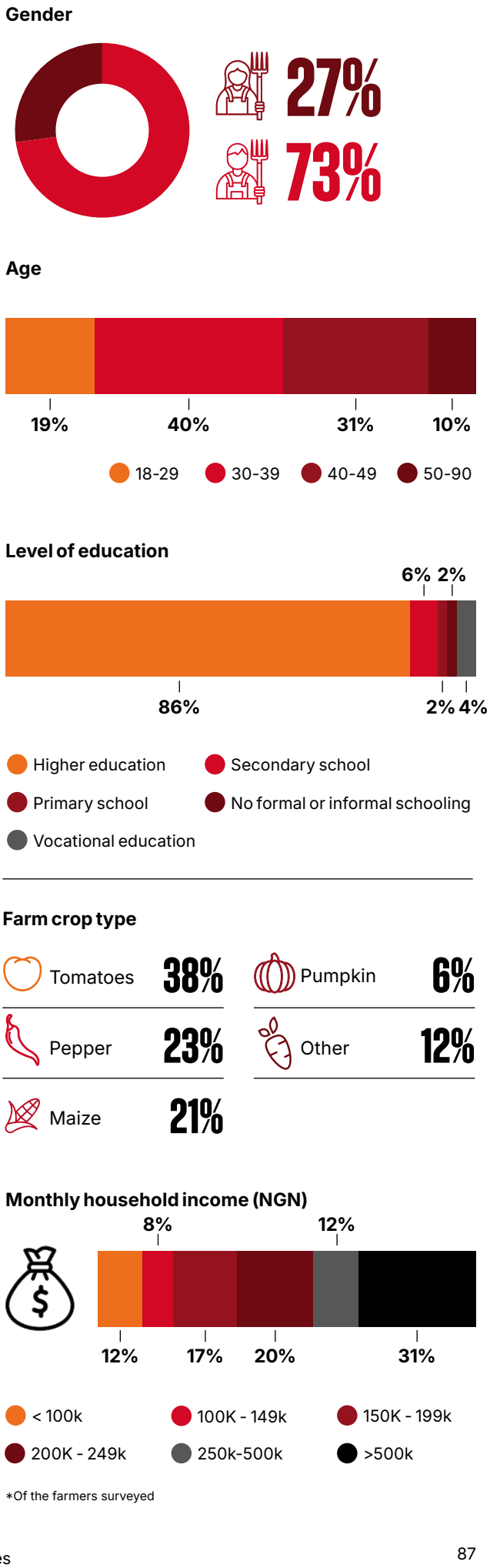
→ Offline, low-tech and no-tech features

Delivery is supported by branded aggregation centres in Lagos, Abuja and Ibadan and trained field teams that coordinate supply and build farmer trust. Pricepally trained over 600 farmers in sustainable practices and strengthened quality checks. It also used agent-assisted onboarding where women farmers had lower phone access, and delivered practical training on crop selection, post-harvest handling, and waste reduction.

Who uses Pricepally?

The typical Pricepally farmer surveyed is a 39-year-old male with higher-than-average education, managing a farm larger than 2.5 hectares and earning a monthly income of NGN 250,000 ($157).

Figure 9: Farmer profile*



*Of the farmers surveyed

Building climate resilience - what changed for farmers?

Improving knowledge and practices to support adaptation to climate stressors

Pricepally's strongest contribution to adaptation is practical planning support to help farmers adjust production to real demand and shifting conditions. The orders system and agent guidance has changed how farmers schedule planting, including staggered or segmented planting to keep supply steady over time. This learning is reinforced by training that is low-cost, workable, and easy for farmers to apply in day-to-day production and post-harvest handling. The survey evidence aligns with this pathway, with 92% reporting that they implemented new farming practices recommended by Pricepally. Farmers' accounts suggest the value is being prepared, with a clear timetable and dependable offtake signals that make it easier to follow through when weather variability and market uncertainty would otherwise disrupt plans.

Improving financial resilience and climate shock absorption

Pricepally strengthened financial resilience by reducing uncertainty around sales, smoothing cashflow, and improving farmers' confidence to make forward-looking decisions. Farmers described a shift from selling monthly to selling weekly once orders were confirmed, which they linked to reduced waste and more regular income. They also highlighted the reassurance of having a reliable buyer and clearer pricing, which reduced the stress of negotiating with inconsistent off-takers and lowered the risk of being left with unsold produce. Farmers report better and fairer prices, sometimes up to double the rates they were previously offered by middlemen, and greater confidence that produce will be collected and paid for, reducing the uncertainty that previously drove financial instability. The

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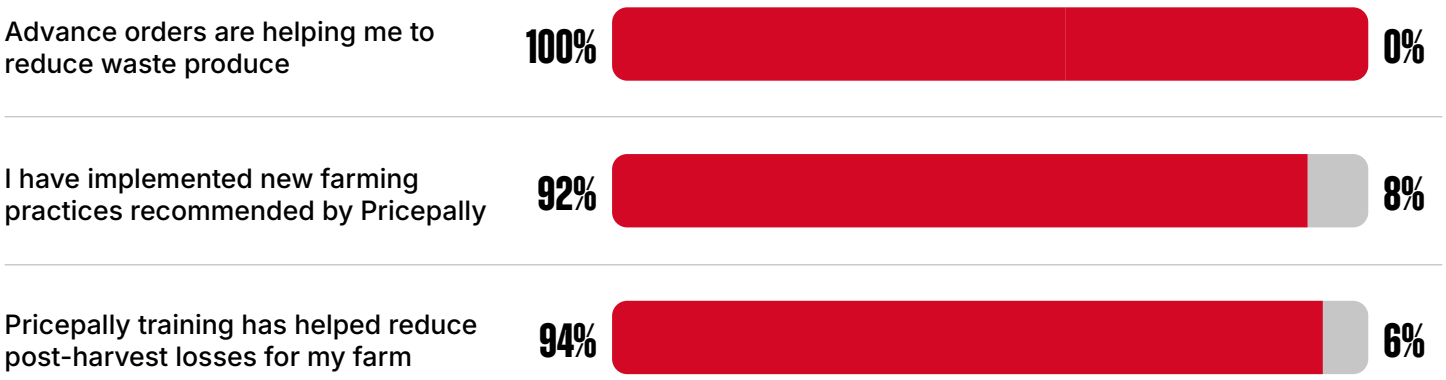
Farmer impact survey

Has the service encouraged sustainable farming practices?

SHARE OF FARMERS RESPONDING YES OR NO



quantitative findings support this resilience, as farmers reported both practice change and loss reduction through training, with 92% implementing recommended practices and 94% reporting lower post-harvest losses, which protects revenue that would otherwise disappear through spoilage. Several farmers also described being better able to anticipate future income, which encouraged investment decisions such as expanding plots or diversifying crops.

Improving environmental sustainability

Pricepally's strongest environmental contribution is food waste reduction. Farmers described significant post-harvest risk before joining, driven by storage and harvesting constraints and unsold crops. Pricepally's advance orders and organised collection directly reduce that exposure, with 100% of farmers surveyed indicating that advance orders helped them reduce waste produce. Training improves practical handling and storage habits that protect quality and extend shelf life, with 94% reporting reduced post-harvest losses after the training. Farmers link confirmed demand and more frequent sales to fewer unsold volumes and less avoidable spoilage.

What did we learn?

Adoption accelerates when support is immediately operational within farmers' existing constraints. Many farmers were already taking practical steps to manage risk, including finding buyers early, supervising transport, and harvesting at cooler hours, yet limited capital, labour gaps, and high transport and energy costs constrained what they could change. Pricepally's strongest contribution was to reduce losses through simple process improvements that worked without requiring expensive equipment. Training reinforced this by focusing on low-cost handling and planning techniques that farmers could apply instantly, while peer learning helped normalise new routines and maintain motivation over time.

Post-harvest loss reduction depends on market certainty, reliable fulfilment and better production practices. Before Pricepally, farmers often sold through fragmented channels where pricing was unpredictable and outcomes could include delayed payments, rejected goods or unsold produce. Pricepally reduced this risk by combining clearer terms on quantity, quality and price with organised logistics and fast bank transfer payments. This reliability enabled farmers to adjust planting and harvest timing to match confirmed demand. The same feedback also underlined that end-to-end consistency is essential, because even short collection delays can quickly reintroduce spoilage and income stress for highly perishable crops.

Women's engagement strengthens when inclusion is designed into recruitment and delivery. Targeted outreach through women-led cooperatives and messaging aimed at women entrepreneurs helped bring more women into the programme, while order scheduling and pooled sales reduced the day-to-day friction of marketing produce. Barriers such as lower smartphone ownership, time constraints, and restrictive social norms limited confidence and consistent use in some locations. Engagement improved when delivery adapted to these realities through agent-assisted onboarding, local language support, and training timed around women's availability. This approach helped women participate more sustainably and reinforced their role in household income decisions.

Digital support tools can strengthen onboarding and ongoing assistance, but they need to be treated as part of the wider service, not a standalone feature. Early use of the AI chatbot created an additional support channel that could help users navigate the platform, particularly where user digital confidence varied. Automated support requires structured testing and refinement in real farmer contexts so that language, requests and common ordering behaviours are handled reliably. Positioning digital support with demonstrations and in-person follow-up helps keep guidance clear and reduces friction during adoption.

SenzAgro

SenzAgro is a Sri Lanka-based startup providing a climate-smart precision agriculture platform that combines on-farm sensors, micro-climate monitoring and predictive analytics to deliver crop and growth stage-specific agronomic guidance. The platform helps growers decide when and how much to irrigate and fertilise, reducing wasted water, energy and inputs while protecting yields. This is increasingly important in Sri Lanka, where rising temperatures, erratic rainfall, droughts and floods disrupt livelihoods and food production, increasing uncertainty for farmers and putting pressure on water systems. By translating weather and soil variability into practical farm decisions, SenzAgro supports agricultural adaptation and resilience.

Our research suggests SenzAgro's smallholder target market includes newer farmers for whom farming is now a primary livelihood, who are experiencing climate impacts directly, and who want to grow their businesses but face weak market access and unfavourable pricing.

With GSMA funding, SenzAgro developed a digital agricultural value chain platform to support farmers in Northern Sri Lanka to adopt sustainable, climate-resilient and regenerative practices through timely weather information, soil health insights, and advisory services and training. The project supported over 2,600 farmers, with 52% reporting implementing recommendations and 41% changing agricultural practices based on the soil tests conducted on their farm.

Country: Sri Lanka

Sector: Agriculture

Business model: B2C

Resilience capacity: Climate adaptation

Find out more: senzagro.com

PROJECT IMPACT

10.5K
people reached

2.6K
farmers supported

How does the solution work?

→ Marketing

SenzAgro drove uptake through in-person workshops, harvest-timed events and gender-aware community outreach, working with local farmer organisations in Northern Sri Lanka. Peer testimonials helped build trust, and face-to-face

engagement proved more effective than digital-only promotion where literacy and confidence with apps varied.

→ Registration

Core users are smallholder farmers, buyers and agricultural SMEs. Farmers are onboarded via field teams and farmer networks, and invited to use the SenzAgro Connect app for advisory services and market linkage.

→ Business model

The platform is free for farmers to encourage adoption, with revenues generated from the IoT Smart Farming offer (subscriptions plus sensor unit sales/rentals) and from marketplace transaction fees paid by buyers and agricultural SMEs. SenzAgro plans to refine fee levels over time, including higher percentage fees for smaller transactions as volumes grow.

→ Mobile and digital technology features

The SenzAgro Connect app provides weather alerts and soil-informed agronomy advice, supported by 20 newly installed automated stations. A digital marketplace matches harvests with registered buyers. To improve engagement, SenzAgro introduced WhatsApp-integrated advisories, visual/voice guidance and smarter notifications.

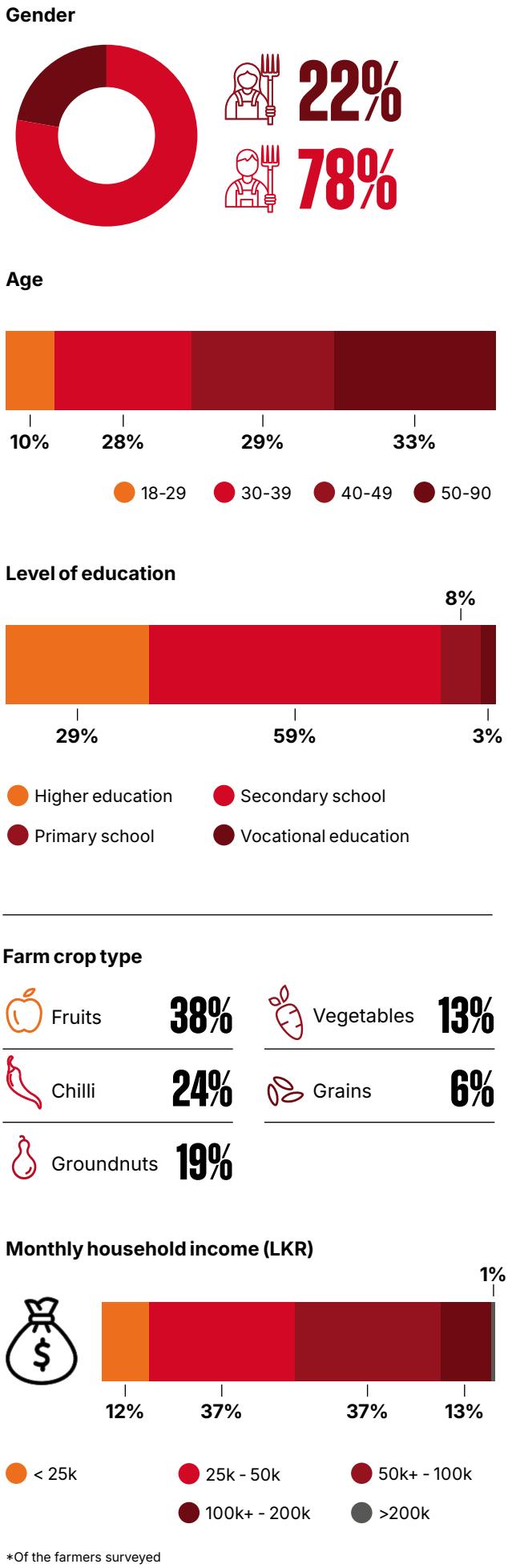
→ Offline, low-tech and no-tech features

Delivery relies on a hybrid model. Field officers, repeated hands-on training and regenerative agriculture workshops build confidence and support behaviour change. Farmers received repeat on-farm soil tests and practical guidance on soil health and organic farming, with localised weather alerts via SMS and the app to support irrigation, fertiliser and harvest planning.

Who uses SenzAgro?

A typical SenzAgro farmer is a 45-year-old male with secondary level education, managing a farm that is less than two hectares in size, and earning around or less than LKR 50,000 ($331) monthly.

Figure 10: Farmer profile*



*Of the farmers surveyed

Building climate resilience – what changed for farmers?

Improving knowledge and practices to support adaptation to climate stressors

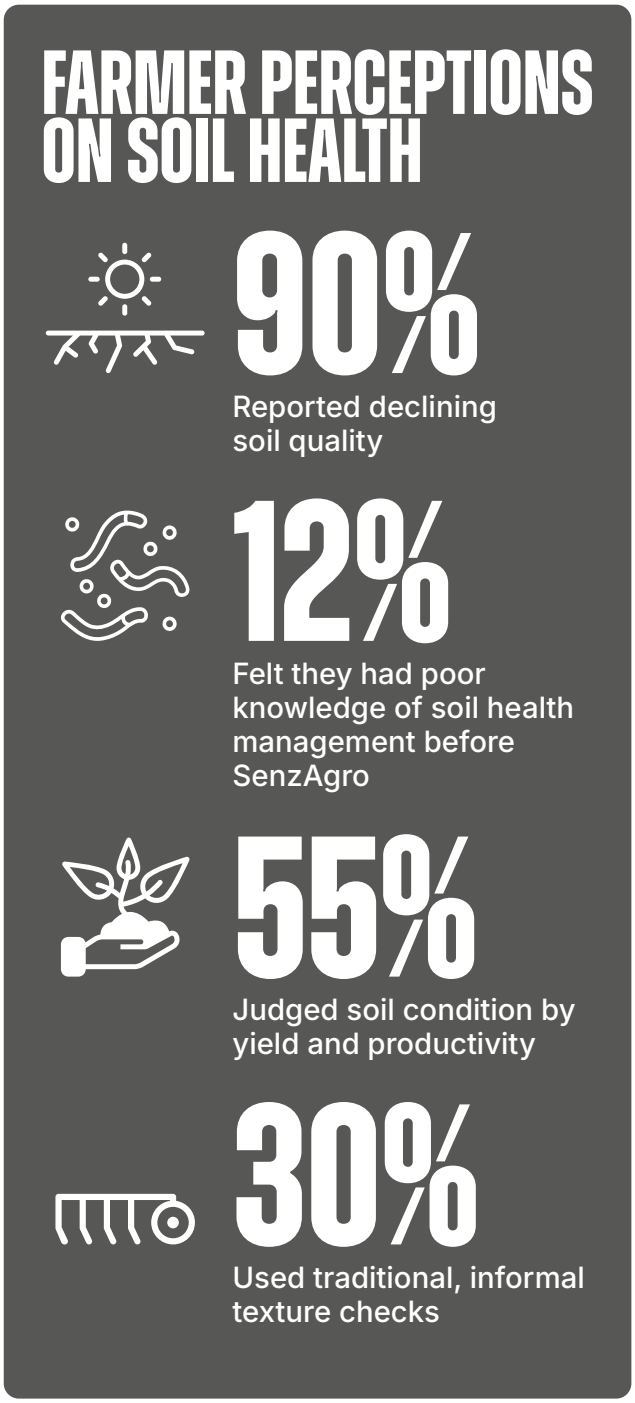
Early outcomes suggest SenzAgro strengthened farmers' capacity to adapt to climate variability by pairing agronomic support with more timely planning information. Nearly half of farmers (45%) reported changing practices following regenerative agriculture training, most commonly around soil testing, fertiliser management and water use, which indicates a shift towards more resilient and resource-efficient farming. Knowledge gains were also evident, with 43% recognising core regenerative concepts, and farmers crediting the training with helping them learn new techniques and build clearer understanding of practices that can be unsafe or counterproductive under changing climate conditions.

Improving financial resilience and climate shock absorption

Signs of improved financial stability also emerged, linked to reported productivity and income improvements. Three in 10 farmers reported income increases associated with SenzAgro services, while a larger share reported higher yields and productivity gains (40%). These early signals suggest the service may help some households stabilise earnings by improving day-to-day farm performance, although outcomes appear uneven across the user base.

Improving environmental sustainability

Environmental sustainability outcomes include shifts towards soil testing, more deliberate fertiliser management, and improved water use for more efficient input application and better resource stewardship, which can reduce waste and pressure on soils and water systems over time. While these results are framed primarily as adaptation and productivity gains, they also indicate an early pathway towards improved environmental performance through more targeted and regenerative farm practices.



What did we learn?

There is a perception gap between soil health and soil testing. Farmers recognised that soil health is worsening, but this did not translate into demand for soil testing or confidence in how to act on results. While around 90% of surveyed farmers reported declining soil quality, only a small minority (12%) felt they had poor knowledge of soil health management prior to engaging with SenzAgro, suggesting a significant perception gap. Many farmers judged soil condition through visible outcomes such as yield and productivity (55%) or by traditional, informal checks of texture (30%). This meant SenzAgro's value proposition had to compete with entrenched proxy measures and a limited understanding of what testing could change.

The service proposition needs to go beyond results delivery into clear, actionable agronomy. Farmers commonly requested more specific guidance after receiving test outputs, particularly for fertiliser quantities and crop choices. Although about half reported implementing advice or considering changes to practices and crop types, perceptions of unchanged findings undermined trust in retesting and raised questions about value for money. This was reflected in willingness to pay. Despite broad stated agreement that soil testing matters, only 47% expressed clear willingness to pay for future tests.

Digital delivery introduces additional friction. Smartphone access was high, yet app engagement remained below 10%. Low digital literacy, unclear terminology, usability issues and bugs reduced confidence, with elderly and female smallholders more acutely facing barriers. Many farmers were also unaware of key features (notably the farming diary and in-app advisory) and struggled to navigate them without hands-on support, meaning uptake depended heavily on field officers and group leaders rather than self-service use.

Market linkage features are constrained by ecosystem readiness as much as technology. The crop marketplace launch was delayed by unclear distribution models, difficulties securing committed buyers, limited farmer updates on harvest data, and resulting misinformation about available stock. SenzAgro improved data availability by shifting from individual self-entry to bulk reporting via group leaders and field staff, recording production information for thousands of farmers over a short period. More broadly, the experience reinforced that meaningful adoption required channel fit and human support. WhatsApp-integrated advisory piloted higher open rates due to familiarity, while in-person training and simpler, more visual or voice-led interfaces helped reduce barriers.

Record-keeping tools support better decisions when they are practised repeatedly and linked to clear seasonal payoffs. Farmer diaries and record keeping are often treated as a useful foundation for better farm decisions, but they only deliver value when farmers can use them consistently and see a clear benefit. In SenzAgro's case, only 41% of farmers already tracked activities, 49% were aware of the digital diary, and reported use was 20%, which suggests that habit formation needs support beyond initial exposure. Wider digital extension evidence similarly finds that uptake improves when tools are simple, reliable, and reinforced with practical follow-up, particularly for users with limited time and confidence using new features. The diary feature should be introduced with short, seasonal workflows, tailored examples, and light-touch troubleshooting that helps farmers move from trial to routine use.

Vitara

Country: Ghana

Sector: Agriculture

Business model: B2C

Resilience capacity: Climate adaptation

Find out more: vitara.ag

Northern Ghana is increasingly exposed to climate shocks. Temperatures have risen by around 1°C since 1960, seasons are becoming more erratic, and heat, drought, and intense storms are reducing yields and undermining rural incomes.[55] These pressures are compounded by rapid deforestation for agriculture, fuelwood and charcoal, which degrades shea parklands that help maintain soil fertility and reduce erosion and desertification. As shea trees are cut for charcoal and fuelwood, nut availability falls, directly threatening a women-led livelihood that is seasonal (typically May to August) and often constrained by limited access to finance, equipment, and fair markets. Many women still sell to local middlemen who set prices, keeping earnings low despite strong global demand for shea in food, cosmetics, and pharmaceuticals.

Vitara is a Ghana-based startup working in the shea value chain to improve market access and incentives for sustainable tree management. The startup supplies traceable shea to international buyers and combines digital traceability with field-based support for women collectors and smallholder farmers. With support from the GSMA Innovation Fund, Vitara implemented a project to strengthen its TreeSyt platform and digitise key parts of shea sourcing in Northern Ghana. The project introduced NFC-based farmer verification, digital weighing, improved inventory and monitoring tools, training on sustainable shea management and support for nurseries that raised 81,323 seedlings. By improving traceability and connecting women more directly to buyers, the project aimed to increase incomes while reinforcing stewardship of shea parklands.

PROJECT IMPACT

435K
people reached

87K
farmers supported

12
international buyer partners

81.3K
shea seedlings raised in nurseries

How does the solution work?

→ Marketing

Vitara promotes its services by linking women's income from shea to climate resilience and tree conservation. The startup uses community engagement and agent-led recruitment to build supply, while buyer-facing communications highlight ethical sourcing and measurable environmental impact to secure high-value contracts.

→ Registration

Field agents register women shea collectors and farmers in Northern Ghana during community visits and training sessions. By using NFC cards to verify identities, the project ensures reliable enrolment and links individuals to their transactions even in areas with limited connectivity or smartphone access.

55. World Bank (2022). Country Climate and Development report: Ghana.

→ Business model

Revenue is generated by supplying traceable, sustainably produced shea to international food and cosmetics markets. This digital traceability system supports premium pricing and long-term buyer relationships. Farmers receive fair and instant payments via mobile money or cash, ensuring stable and improved incomes.

→ Mobile and digital technology features

The TreeSyt platform includes NFC-based verification, Bluetooth-connected weighing scales, and a platform for buyer-facing transparency. TreeSyt also features a Green Tracker that uses machine learning for plant health monitoring and is integrated with MTN Ghana Mobile Money for seamless digital payments and credit services.

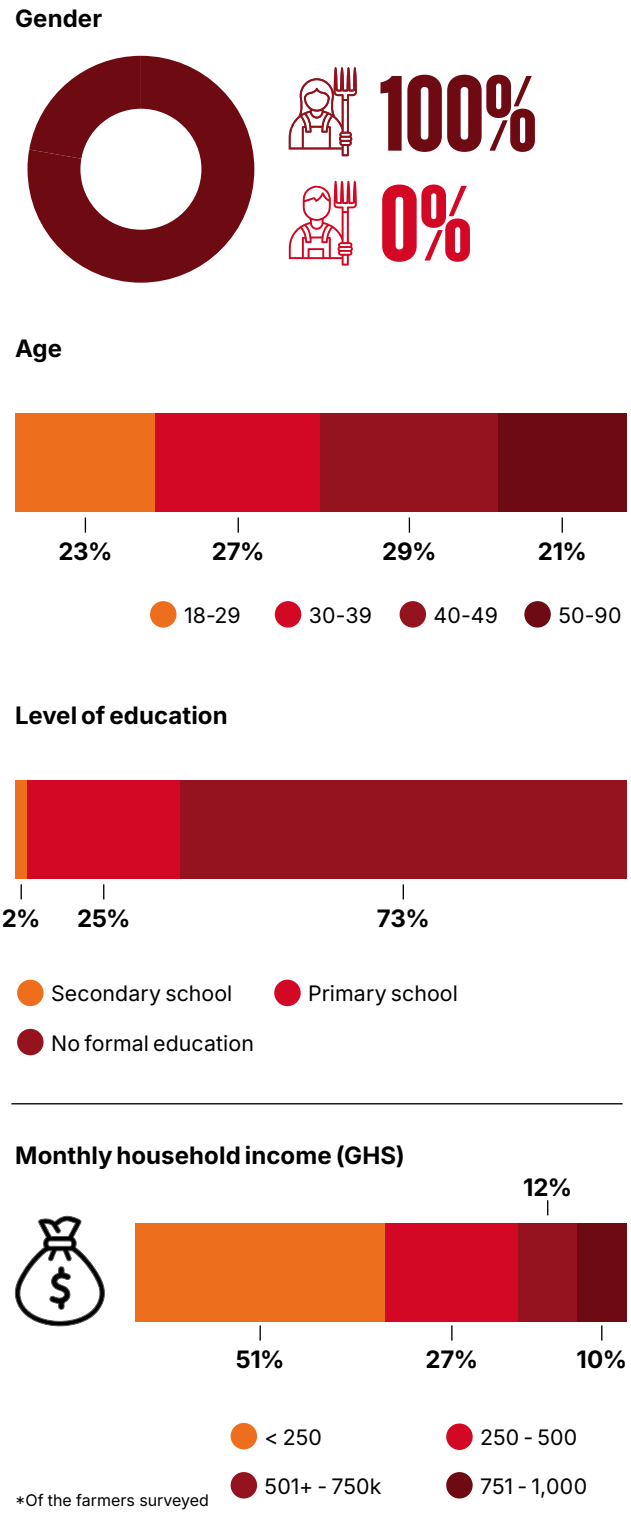
→ Offline, low-tech and no-tech features

Vitara field agents provide coaching on conservation and support nursery establishment and seedling distribution. Physical identification cards and digital weighing reduce transaction disputes. Crucially, the TreeSyt app works offline, allowing agents to capture data in remote locations and synchronise when connectivity is restored.

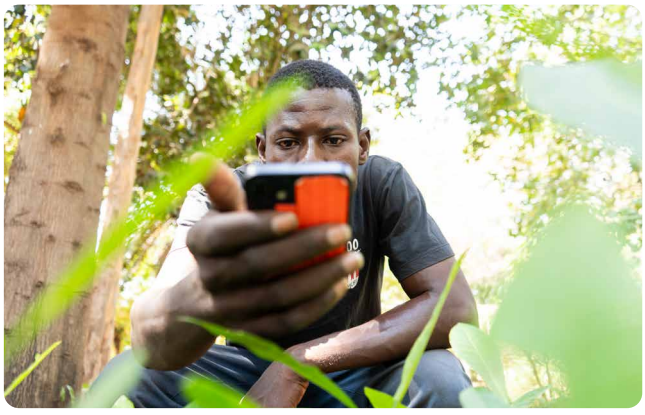
Who uses Vitara?

A typical user of Vitara's services is a female smallholder farmer who is approximately 39 years old with no formal education. They are most likely to own less than two hectares of land, with a personal monthly income of less than GHS 250 ($24). All Vitara service users interviewed as part of our research were women, which demonstrates a key economic opportunity for almost 470,000 women farmers in Northern Ghana, where women play a central role in the shea value chain, from harvesting nuts to processing and selling shea butter.[56] Outside of harvesting shea, all of the farmers interviewed are conventional farmers too, growing crops such as maize or groundnuts. However, only 13% of female farmers interviewed reported that they are the decision-maker for their conventional farms, with the majority indicating that their spouses make final decisions on farming.

Figure 11: Farmer profile*



*Of the farmers surveyed



56. Livelihoods (2021). Regenerating The Shea Butter Tree.

Building climate resilience - what changed for farmers?

Improving knowledge and practices to support adaptation to climate stressors

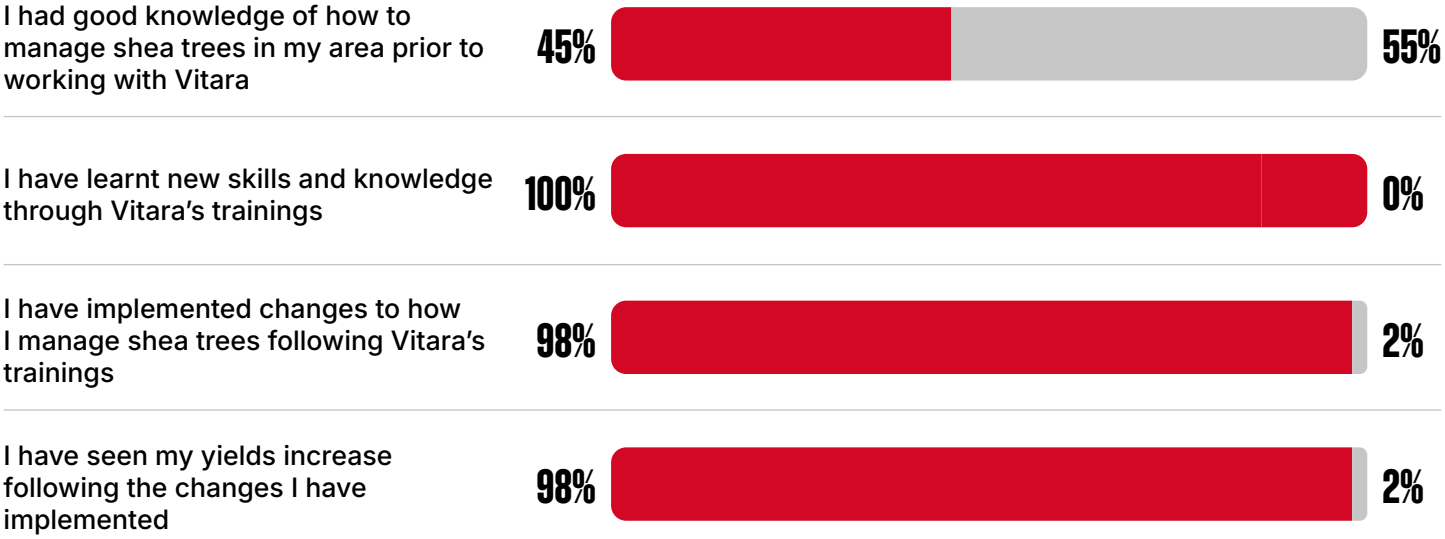
Vitara's training translated into practical behaviour change. While 45% of respondents said they had good knowledge of how to manage shea trees prior to working with Vitara, all respondents said they have learned new skills and knowledge through Vitara's trainings. Critically, 98% report implementing changes to how they manage shea trees as a result of Vitara's trainings.

Farmers also associate these changes with improved production outcomes, with 98% seeing yields increase following the changes they have implemented, suggesting that the practices taught are perceived as relevant to current climate stressors and are feasible to adopt within existing farming routines. Overall, the results point to a strong pathway from training to action, and from action to perceived improvements in productivity, which is a core component of climate adaptation capacity.

Farmer impact survey

Is the training on sustainable shea harvesting helpfull?

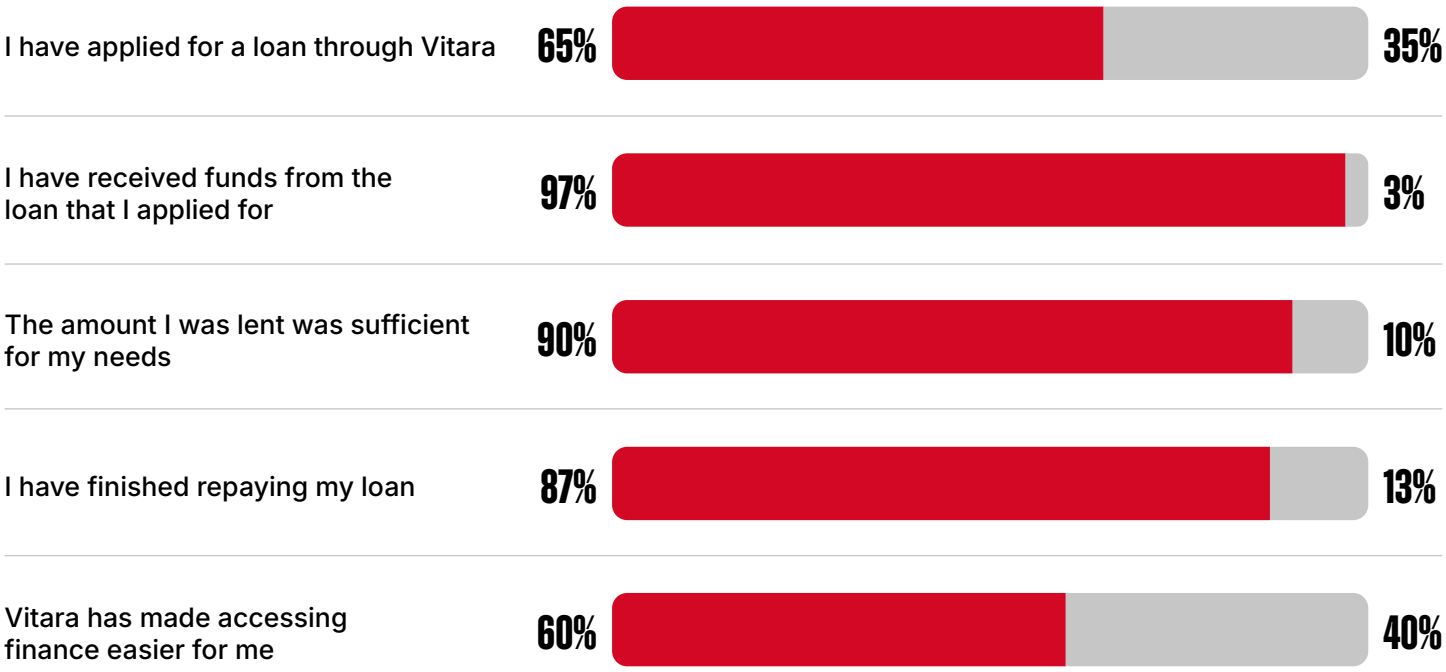
SHARE OF FARMERS RESPONDING YES OR NO



Farmer impact survey

Is the loan financing service helpful?

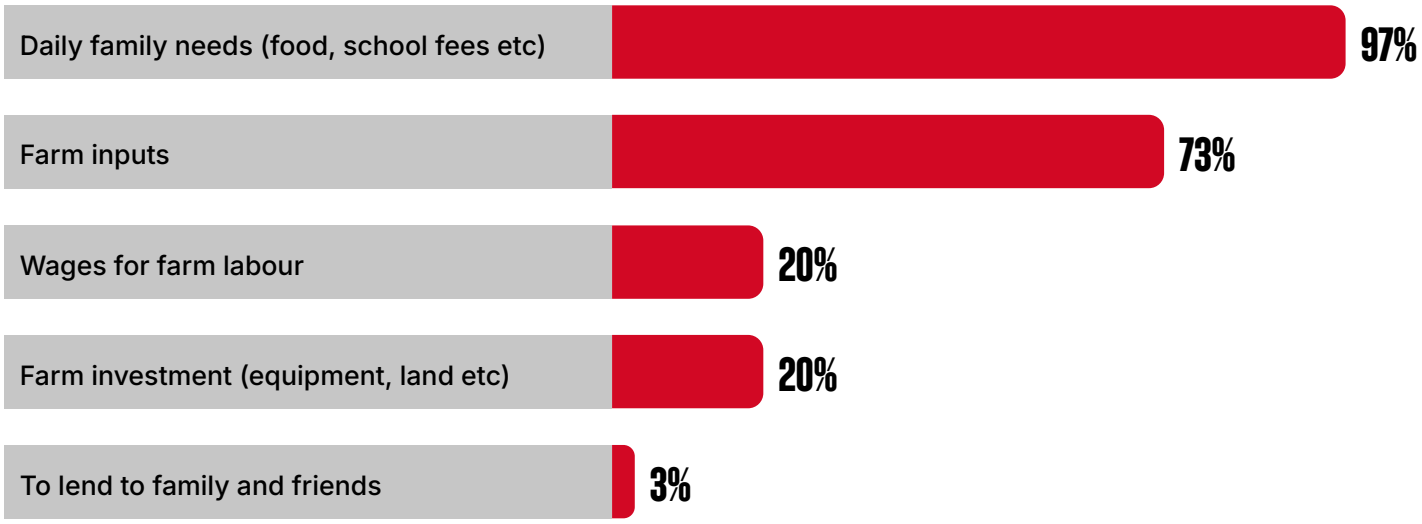
SHARE OF FARMERS RESPONDING YES OR NO



Farmer impact survey

What are the farmers using the loan funds for?

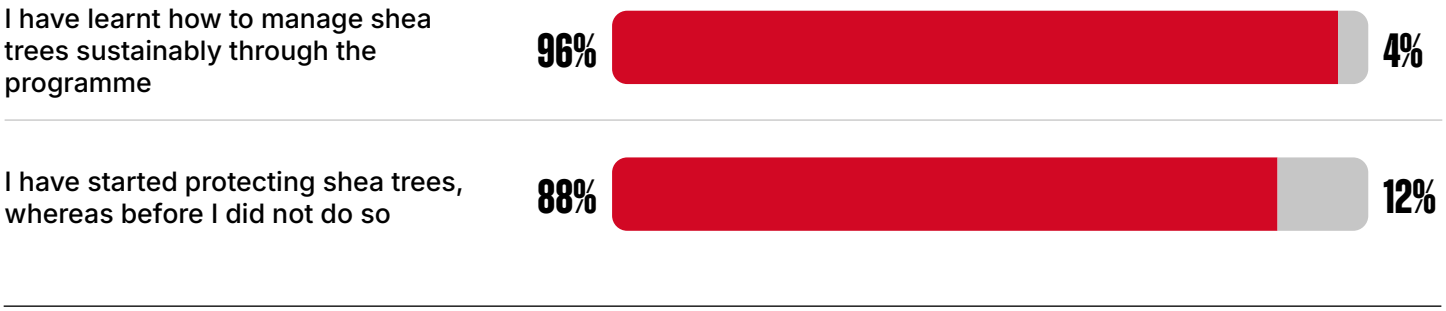
SHARE OF FARMERS RESPONDING YES



Farmer impact survey

Is the shea conservation programme helpful?

SHARE OF FARMERS RESPONDING YES OR NO



Improving financial resilience and climate shock absorption

Vitara's loan offer provides timely liquidity to help farmers manage seasonal cashflow gaps and cope with climate-related income volatility. Uptake is meaningful and approvals are strong, with 76% of farmers requesting a loan of less than GHS 500 ($48), an amount most believe to be sufficient for their needs, and 97% of applicants reporting they received the funds they applied for. Reported repayment is also high, indicating the product is generally workable within farmers' income cycles.

Loans are most often directed to immediate household needs and maintaining farming activities, rather than larger investments. This points to the loan acting as a practical safety net that reduces pressure to use harmful coping strategies during lean periods, demonstrating their resilience.

Not everyone reported that Vitara made finance easier to access, but this is not necessarily a reflection of service quality. Some farmers had established ways to borrow through other channels, so Vitara's loan offer is an additional option that strengthens choice and flexibility, rather than being the first source of credit for all users.

Improving environmental sustainability

Vitara's conservation programme helps communities treat shea trees as managed assets. Through practical training and regular follow-up from trusted field agents, women farmers learn what sustainable management looks like locally. They apply these lessons by protecting mature trees, reducing harmful cutting, and improving harvesting and handling during the season. This shift is visible in reported behaviour change, with 88% indicating they started actively protecting shea trees after joining.

Environmental impact is reflected in the establishment of 102 parklands and agroforests covering 994 hectares. These areas provide vital ecosystem services such as erosion control and pollinator habitats, while offering strong estimated carbon sequestration potential. By raising over 80,000 seedlings and training 17,000 farmers in conservation, the project exceeded its land protection targets. Vitara has also identified future opportunities to reduce its operational footprint, particularly regarding emissions from shea pre-treatment and transport.

What did we learn?

Women can lead the value chain even when they do not control all farm decisions. Vitara's user base is overwhelmingly female, and all research respondents were women, yet only 13% reported being the final decision-maker for conventional farming, often because men own land or control major assets. Day-to-day decisions are frequently made by women, which creates a practical entry point for service adoption. This includes training, tree protection and quality handling. Women's operational autonomy should be considered during design, while also addressing structural constraints through access to finance, market transparency, and mechanisms that strengthen women's bargaining power within households and producer groups.

Scale is most valuable when quality keeps pace, as depth of engagement can outperform rapid onboarding. After exceeding farmer registration targets, Vitara deliberately slowed recruitment to deepen services. This included training, conservation support and pre-financing to prioritise retention and repeat participation. It ensured the platform's benefits, such as verified transactions, fewer disputes and stronger buyer confidence, accrued to both farmers and the enterprise. More users does not equal more impact, especially in seasonal value chains where long-term trust and repeated transactions determine outcomes.

Ecosystem partnerships can accelerate delivery when they are tightly linked to user value. With facilitation support, Vitara partnered with MTN Ghana and signed an agreement with MTN Mobile Money to integrate the MoMo payments API. This enables faster, more secure and more traceable payments. It reduces reliance on cash and supports transparency across farmer, cooperative, and buyer transactions. Partnerships work best when they remove a concrete bottleneck, such as payments, liquidity or verification, rather than adding complexity.

Tech adoption depends on trust infrastructure. Field agents are not optional in low-connectivity contexts. TreeSyt improved in response to feedback and operational needs. Updates included NFC verification, Bluetooth scale integration, improved profiling, and farmer support services. But constraints persisted, including low digital literacy, smartphone and data costs, and patchy connectivity. Vitara's agents therefore became the backbone of adoption. They coached farmers, resolved issues, and bridged offline-to-online workflows through an app that can function offline and synchronise later. Budgeting and planning for the human layer should be a core product functionality, not a temporary rollout cost.

Conservation is strongest when communities can see and feel the economic return. Reported shifts in protection behaviours sit alongside evidence of improved market access and financing. This reinforces a key programme insight that environmental outcomes are most durable when paired with tangible household benefits. When farmers associate tree protection with reliable demand, fair measurement, and faster payment, conservation moves from good practice to good business.

UjuziKilimo

Kenya's climate crisis is marked by hotter temperatures and more erratic seasons. Droughts, intense rainfall and flooding create increasingly uncertain planting dates, water use and nutrient management. By combining micro-level soil diagnostics with location-specific recommendations and weather information, Kenyan agri startup UjuziKilimo helps farmers adapt to applying the right inputs at the right time, cutting costs and protecting yields under variable conditions. Our research with smallholder farmers in Kenya demonstrated that they lack reliable access to trustworthy sources of information to support their farming practices. They also reported a lack of institutional support in adapting their farming practices to climate change, and no expectations of receiving such assistance.

Supported by the GSMA Innovation Fund, UjuziKilimo has scaled a platform to advance data-driven decision-making for farmers in Kenya. The funding helped UjuziKilimo deploy IoT-integrated soil testing kits and enhance its soil advisory features with insights on soil health, local weather, disease outbreaks and best crop management practices.

How does the solution work?

→ Marketing

UjuziKilimo promoted soil testing through local market field days, roadshows and radio adverts, backed by direct, face-to-face engagement. Farmer research showed uptake improved when in-person outreach was supported by simple digital follow-up, and when trained local agents could explain the value of soil health recommendations.

→ Registration

The main users are smallholder farmers in Kenya. Farmers join through UjuziKilimo's agent network, where agents recruit farmers in communities, conduct SoilPal tests on-farm, and register results against the farmer's record. Farmers then receive their soil test results and crop recommendations.

Country: Kenya

Sector: Agriculture

Business model: B2C

Resilience capacity: Climate adaptation

Find out more: ujuzikilimo.com

PROJECT IMPACT

123K
people reached

20.6K
farmers supported

24K
soil tests conducted

→ Business model

The service is primarily paid per soil test, including recommendations. The project began with a freemium approach but transitioned to paid-only tests to improve sustainability. Soil tests are conducted and users receive the results via SMS within five minutes, providing them with information on soil health, nutrient levels and recommendations. For an extra payment, farmers can receive additional information on local weather, disease outbreaks and good crop management practices. Revenue is a blended mix of direct-to-consumer testing via agents and business-to-business sales through partners.

→ Mobile and digital technology features

The project scaled SoilPal, an IoT soil testing device linked to a data platform that organises results and generates crop recommendations, expanding from 30 to 50 crops. Digital tools support agent-led data capture, faster turnaround of results, and improved engagement.

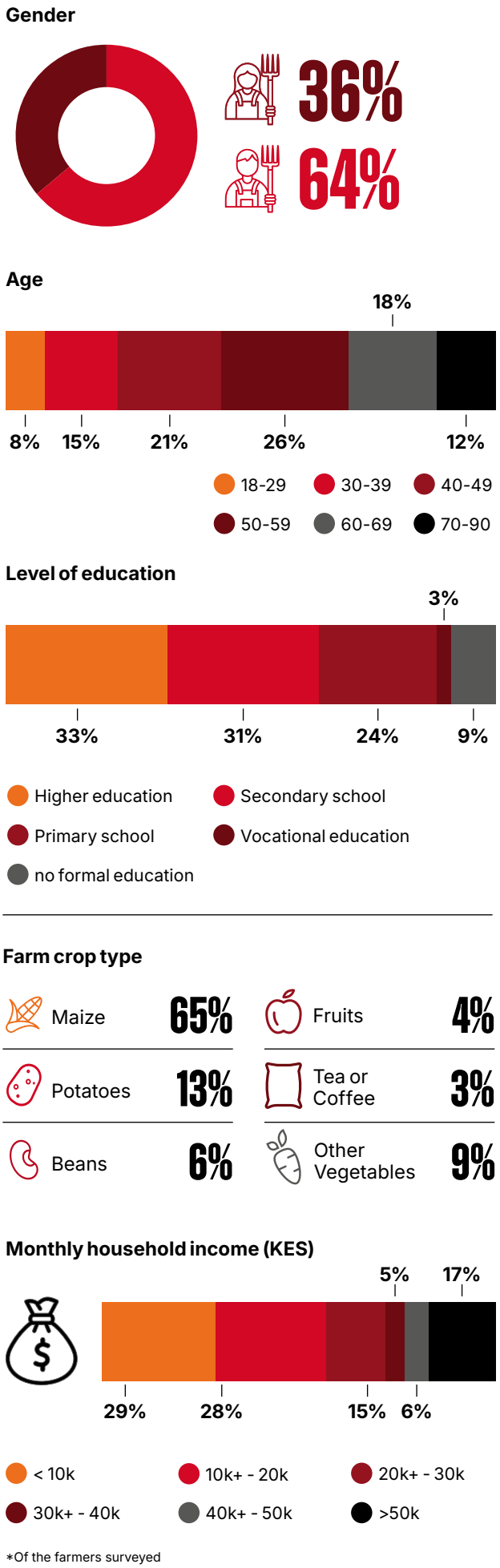
→ Offline, low-tech and no-tech features

Physical soil testing kits are administered by local agents travelling to farms, which makes the service accessible to areas where laboratories are far away. Agent training reduced device mishandling and sensor replacements, improving reliability. Adoption was strengthened through repeated in-person sensitisation, practical demonstrations at roadshows, and trust-building within rural communities.

Who uses UjuziKilimo?

A typical user of UjuziKilimo's services is a smallholder farmer who is approximately 50 years old and has completed secondary school education. They are most likely to own less than two hectares of land, with a personal monthly income of less than KES 15,000 ($115). Overall, the profile of farmers surveyed is broadly consistent with the national average for age of farmers in Kenya,[57] as well as farm size and faming crop type.[58,59]

Figure 12: Farmer profile*



*Of the farmers surveyed

57. Kenyan Ministry of Agriculture & Livestock Development (2019). Agricultural Census.
58. Kenya National Bureau of Statistics (2024). National Agriculture Production Report.
59. Kioko, J.N. (2022). Overview of Kenyan Agriculture. Kenyan Ministry of Agriculture & Livestock Development.

Building climate resilience - what changed for farmers?

Improving knowledge and practices to support adaptation to climate stressors

Soil testing was not a routine part of farm decision-making, with 93% of farmers reporting they had never conducted a soil test before engaging with UjuziKilimo. Farmers relied mainly on observation to judge soil health, most commonly using crop yield and productivity as their primary indicator, rather than measures such as soil pH or structure. Of those surveyed, 72% of farmers now report better access to a soil testing service. This shift supports more informed responses to climate stressors, including erratic rainfall and heat, and farmers can use soil results to identify constraints, plan nutrient applications more precisely and make adjustments that protect yields under changing conditions. UjuziKilimo helps farmers move from symptom-based assessment to evidence-based adaptation, strengthening decision-making when weather patterns become less predictable. Following the service, 80% of farmers reported a better understanding of soil health and its implications for their farming practices. This has translated into action, with 84% implementing recommendations because they considered them relevant and useful. Farmers also reported agronomic benefits, with 79% noting improvements in crop quality and 75% reporting increased yields.

Improving environmental sustainability

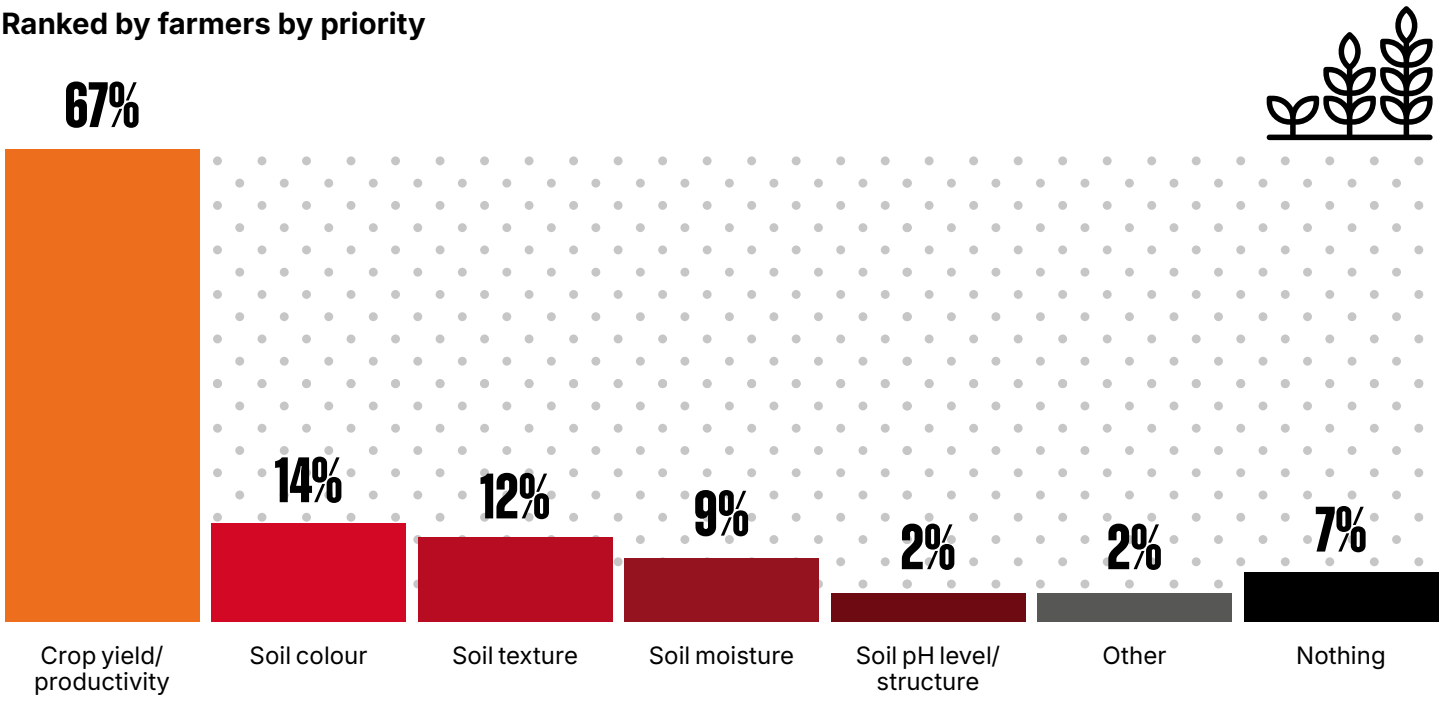
UjuziKilimo has strengthened farmers' understanding of soil health and enabled practical changes in how inputs are used. Chemical fertiliser use has reduced, with 75% of farmers applying less because of the guidance received. By clarifying what is needed and what constitutes over-application, the service helps farmers avoid wasted inputs while reducing risks to soil ecology and the wider environment. These changes support healthier soils and more efficient resource use under increasing climate pressure.

What did we learn?

Build trust by starting with simple, locally relevant awareness and guidance. Prior to using UjuziKilimo's service, 93% of farmers reported they had not previously conducted a soil test, often because they were unaware that services existed or were unsure how testing would translate into practical benefits for their farm. This highlighted that introducing a new climate-tech service is not only about onboarding to a product, but also about building confidence in a new way

INDICATORS FOR SOIL HEALTH

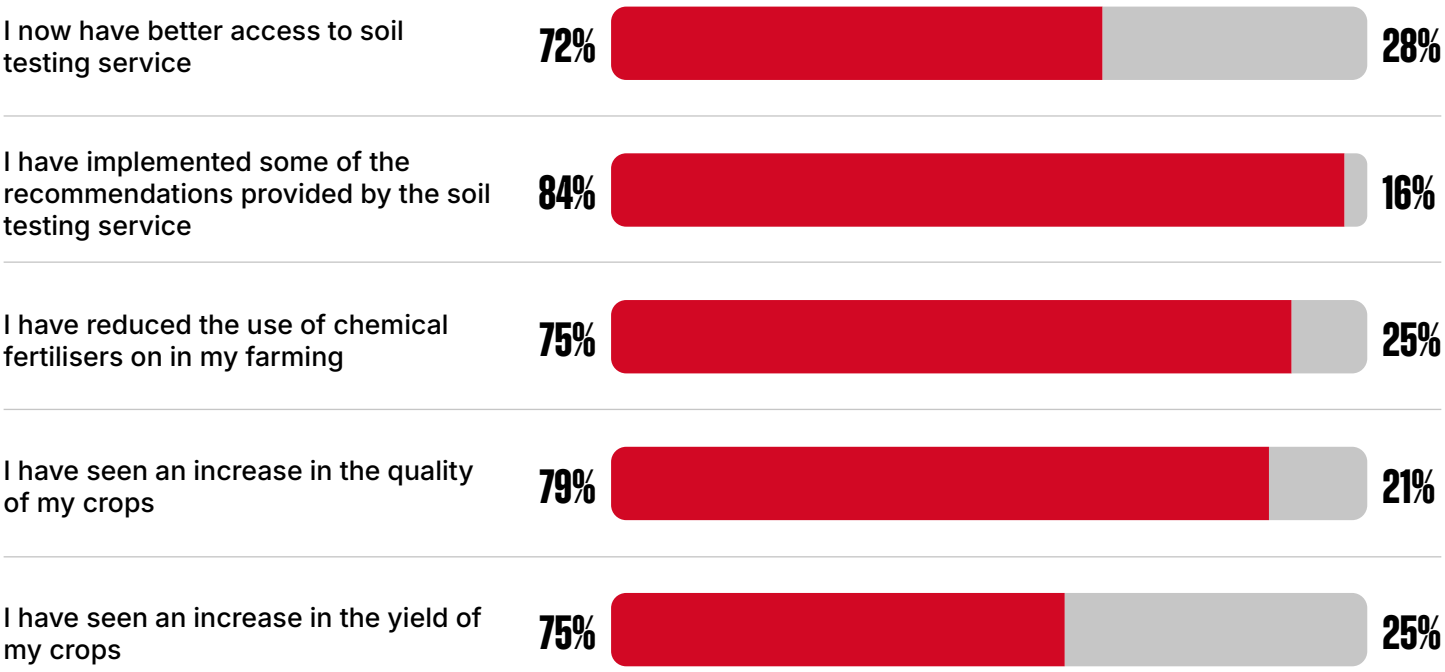
Ranked by farmers by priority



Farmer impact survey

Is the soil testing service helpful?

SHARE OF FARMERS RESPONDING YES OR NO



of working. Field agents played an important role in bridging this gap, helping farmers understand what to expect and why the service was useful. UjuziKilimo's experience suggests that investing in category-level awareness of why soil health testing matters, with clear explanations of locally visible benefits, can reduce perceived risk and increase engagement. When farmers can link testing to outcomes they care about, uptake becomes more natural and sustained.

Keep recommendations actionable by offering phased options and realistic alternatives. Farmers valued the service for providing data-driven agronomic recommendations and hands-on support to interpret results and plan next steps. At the same time, a minority of farmers found it harder to act immediately on some recommendations when inputs were expensive, temporarily unavailable, or difficult to access locally. This points to an opportunity to make guidance even more practical under everyday constraints. For example, recommendations can be presented as prioritised steps, starting with minimum viable actions that improve soil health, and building towards more complete interventions over time. Phasing actions across seasons can help spread costs and effort, while suggesting substitutes or locally available options can keep momentum when markets are unpredictable. Where relevant, signposting credit, subsidies, or trusted suppliers can further support follow-through and reinforce farmer confidence.

Affordable testing creates a repeat engagement cycle and a strong base for expanded advice. Operationally, the soil testing device offered a more affordable route than conventional lab testing, which is often around twice the cost. Most farmers indicated they would repeat soil testing annually, creating a clear cycle for ongoing engagement and learning, even if testing is not frequent. This repeat touchpoint also provides a strong foundation for additional advisory services. Farmers anticipated value from practical add-ons such as SMS alerts on disease outbreaks, reflecting how many currently seek crop health advice through local agrovets. Over time, UjuziKilimo can build on soil test histories and farmer profiles to provide increasingly tailored recommendations, including using AI where appropriate. This positions the service as a continuing support channel that deepens its value with each season.

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