CIFAR ALLIANCE

GSMA Mobile for Development

MSC MicroSave Consulting

Resilient farming in the digital age: Overcoming AgTech adoption challenges in Africa and Asia

Roundtable Report

Foreword

Resilient and efficient food systems are critical to addressing rising global food insecurity. With the world's population set to grow by nearly a billion people in the next two decades—and rising incomes driving higher consumption—food demand is expected to increase by more than 50%, possibly up to 70%, by 2050. Yet 783 million people already face hunger today. Smallholder farmers in low-and middle-income countries, who produce up to 80% of the food consumed in Asia and Sub-Saharan Africa, are essential to meeting this demand but remain highly vulnerable to climate shocks and systemic barriers.[1] Digitalisation holds immense promise for addressing barriers and strengthening climate resilience—but adoption remains low, and the majority of agritechs are far from scale. As climate shocks intensify and funding becomes more constrained, we cannot afford to get this wrong.

It is precisely this context that makes honest, evidence-driven dialogue so essential. Too often, the sector gravitates toward optimistic narratives without pausing to examine what is genuinely working, what is failing and why. Given the limited donor and investment capital available, we need to prioritise solutions that are designed with the farmer in mind, and that demonstrate a path to sustainability and scale. We must be candid about the barriers—digital literacy, affordability, trust, gender inequities, and fragmented value chains—and equally candid about where our collective approaches need to evolve.

This roundtable, convened during London Climate Action Week 2025, brought together leaders across agriculture, technology, finance, and development for exactly this type of frank exchange. The discussions surfaced critical insights and lessons, which are captured throughout this report. We extend our sincere thanks to all participants who shared their experience, data and hard-won lessons. Your contributions ensure that, together, we can continue to advance digital agriculture solutions that truly strengthen farmer resilience in a changing climate.

GSMA and MicroSave Consulting co-chair the Climate Resilient Agriculture CoLab of the CIFAR Alliance. We were delighted to create an opportunity where practitioners could speak openly—not only about successes, but also about the failures and pivots that shaped their journeys. This openness is vital; progress will come not from celebrating only what works, but from learning deeply from what doesn't.

Ashley Olson Onyango

Head of Financial Inclusion & AgriTech, GSMA

Graham A.N. Wright

Chair, MicroSave Consulting

[1] GSMA. AgriTech Accelerator Lessons from Scaling Digital Agriculture Services. 2025

Introduction

This report is based on an off-the-record discussion on the adoption and use of AgTech by a broad group of thought leaders from the agriculture sector, whom the GSMA and MSC brought together as part of London Climate Action Week held on 26th June 2025. They explored how AgTech can be used to enhance climate resilience and crop productivity.

Despite its potential, digital AgTech adoption among smallholder farmers in Africa remains low, with only 13% registered and just 5% who actively use digital services.

The roundtable explored a proposition that runs counter to current trends. Donors allocate only limited resources to digital AgTech. Therefore, careful allocation is vital. To ensure optimum utilization, the resources should be directed toward understanding what smallholder farmers truly need and what they are willing and able to pay for. Donors also need to understand how to deliver digital solutions that can address farmers' problems in a sustainable and commercially viable way. Key stakeholders should emphasize ways to scale existing solutions, rather than promote the creation of new startups. This step could help them maximize the value of these investments.

The roundtable revealed some conclusions, which form the basis of the subsequent sections of this report.

Recommendations for AgTech growth

- **Farmer-centric design**: A farmer-first approach is critical. Stakeholders need to prioritize methodologies, such as human-centered design (HCD), to develop acceptable and affordable solutions based on the actual needs of smallholder farmers. They should develop customized AgTech solutions with compelling value propositions, utility, and ease of use to respond to the diverse needs of a variety of farmers. AgTechs need to have the resources to evaluate new products or services flexibly. Stakeholders should support AgTech providers with a high potential through HCD and A/B testing to optimize and scale their products and services for their target markets. Low-tech solutions are important to nurture farmer-centric designs, and forefront technology is not always the best solution.
- **Human-tech integration**: Stakeholders need to invest in phygital (physical + digital) models that combine human extension agents with digital tools to build trust and ensure usage. This will often entail ways to prioritize technology in the hands of agents or extension workers to assist farmers. Stakeholders face a trade-off between scale and unit economics, where they have to choose between digital and physical delivery.

  Physical delivery creates a minimum cost threshold that cannot be crossed. Stakeholders need to conduct research to understand how to optimize the use of agents and digital tools to support these agents. Stakeholders also need to understand how to transfer digital skills from the agents to the farmers they support.
- **Use value chain actors:** Stakeholders should use off-takers for embedded finance in markets that offer a commercial incentive to secure produce supply. In such instances, off-takers offer an affordable, fit-for-purpose, and commercially viable alternative to financing the adoption of AgTech solutions at scale. Traditional banks or MFIs are unlikely to finance smallholder farmers directly.
- **Sustainable financing models**: Stakeholders need to recognize the spectrum of approaches to deliver AgTech solutions, from humanitarian to commercial. They should align these instruments, whether grant, equity, or debt, with the need and desired outcome. Such an alignment will create an opportunity and imperative for better focus and coordination among different financial institutions and other stakeholders, especially in the context of today's reality, where development and donor funding have started to dry up.

  We need to develop a continuum and smoothen handovers between finance and different ecosystem stakeholders to help commercialize AgTechs of all forms. We need to redirect limited donor resources to identify and scale existing high-potential solutions and bridge the "valley of death" rather than fund new startups that have not embedded a pathway for scaling from their inception. We should blend finance with first-loss guarantees and other instruments, which include parametric insurance, to reduce the cost of capital and crowd-in commercial funds.

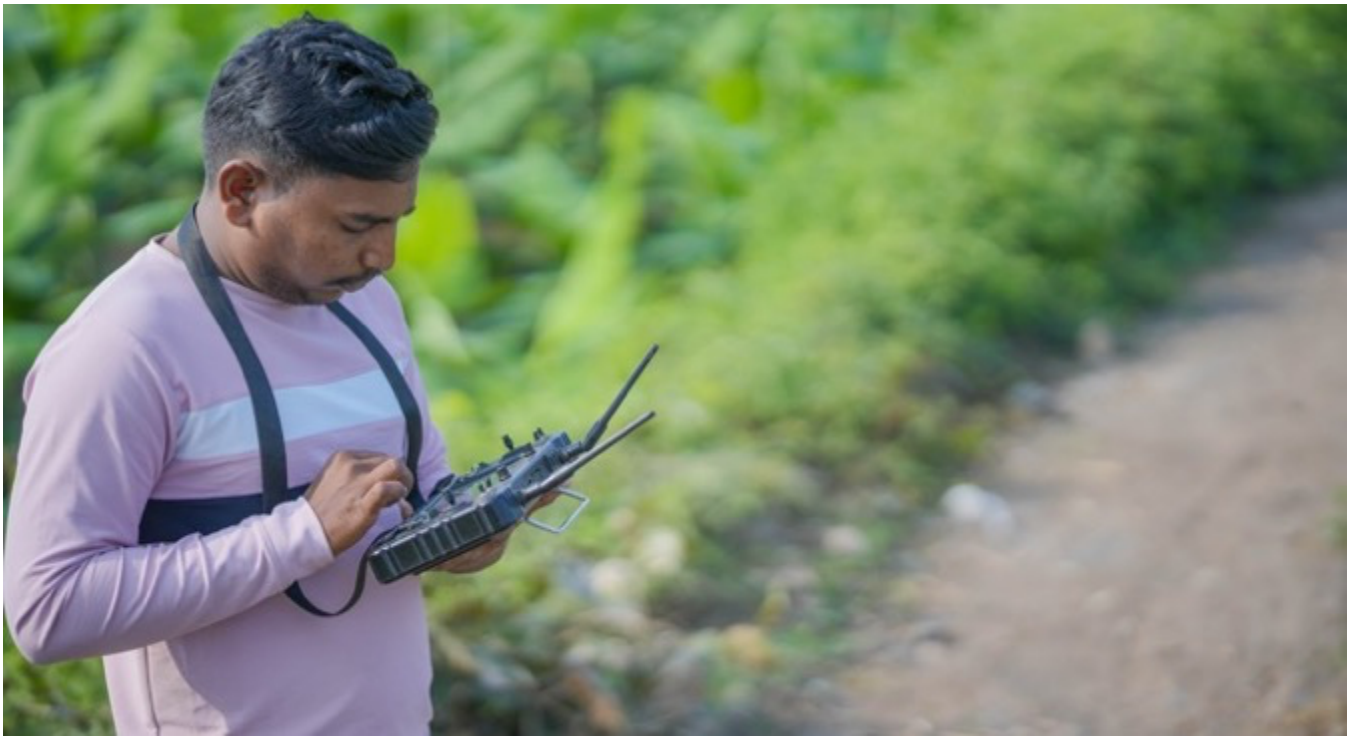
  Governments and financial institutions will have to play a critical role to support the ecosystem, increase their risk appetite, and prevent market failure. They need to safeguard

AgriTechs, off-takers, and smallholders who absorb most of the risk. Development finance institutions play a vital role in this, but need to be encouraged and willing to take on more risk. This would infuse additional private and commercial capital. Overall, stakeholders need to customize investment strategies or financing models to market realities, such as seasonality, to meet the needs and revenue cycles of AgTechs.

- **Policy and infrastructure support**: Stakeholders need to advocate and finance digital public infrastructure, such as AgriStack. This decision will provide foundational support and reduce capital and operational costs for AgTechs, which include acquisition and targeting costs. AI can potentially add significant infrastructural value, but the 4AS model (affordability, availability, acceptability, accuracy, and security) needs careful attention.

  Governments and other financial institutions need to support smart government policies, such as tax exemptions or tapering subsidies, to mitigate the risks associated with adoption and prevent market distortions. They need to design and deliver subsidies based on the stage of the innovation and create a level playing field with standards. Stakeholders should promote public-private partnerships to accelerate investments and deployment of digital public infrastructure.

- **Collaboration and knowledge sharing**: Stakeholders should promote multi-stakeholder platforms to align funders, corporates, such as fast-moving consumer goods' (FMCG) off-taker commitments, and startups, for coordinated impact. They need to enhance monitoring, evaluation, and learning around the lessons from AgTech and apply them to overcome the valley of death.



Introduction

As part of London Climate Action Week, on 26th June 2025, GSMA and MSC (MicroSave Consulting) brought together thought leaders on agriculture (see Appendix 1). They discussed how to increase the adoption of AgTech and enhance climate resilience and productivity. This roundtable sought to build on pillar 2 of the CIFAR Alliance's Climate Resilient Agriculture (CRAg) white paper, namely, the diffusion of innovation across value chain participants.

Despite its potential, the adoption of digital AgTech among smallholder farmers in Africa remains low, with only 13% registered and just 5% actively using digital services (Chandra and Collis). Low adoption rates result in slow and limited growth for digital AgTechs. Only 2% of solutions reach more than 1 million users, while most reach between 1,000 and 50,000 farmers. These numbers present an often unsustainable user reach for AgTechs to be viable and continue operations in the long term. Recent high-profile failures of well-funded digital AgTechs, such as iProcure and Gro Intelligence, as well as the struggles faced by Twiga Foods, underscore these challenges.

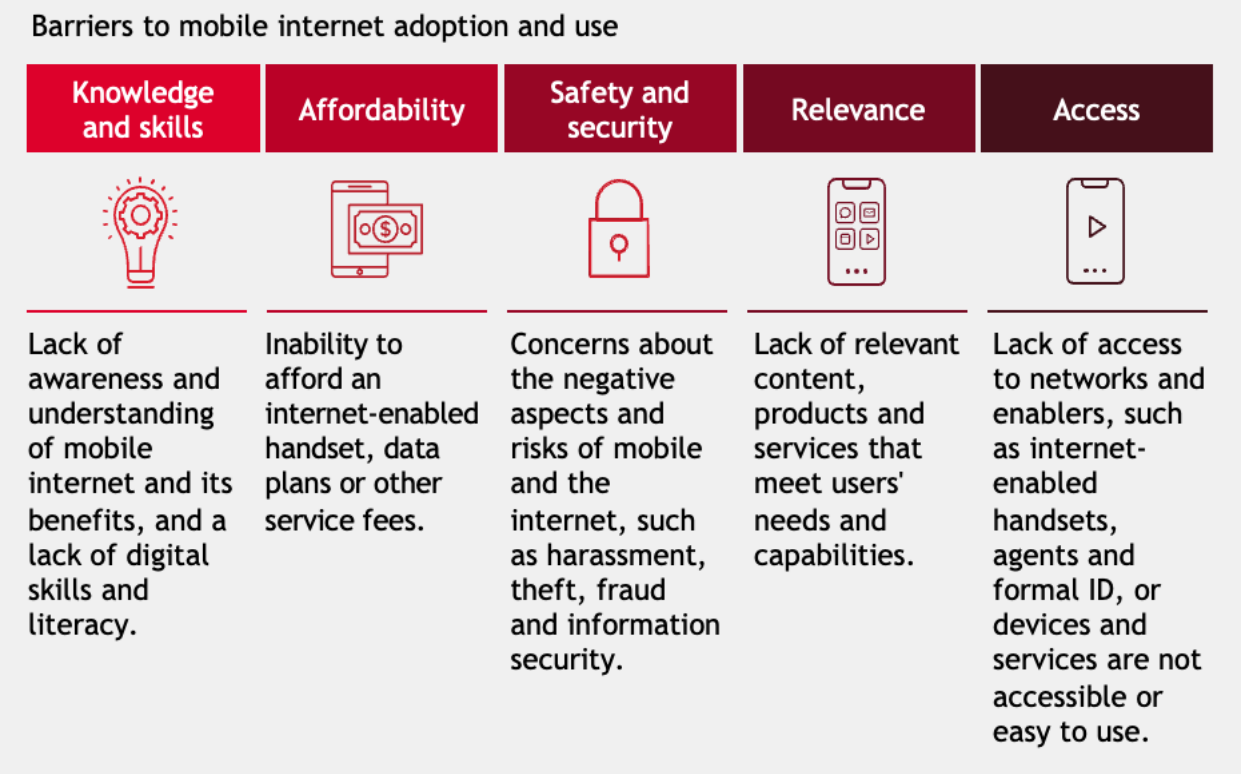
Nonetheless, some digital AgTechs have achieved scale and are moving toward, while others have even achieved sustainability. Pula, AFEX Commodities Exchange, One Acre Fund and Apollo Agriculture are some examples of successful AgTechs.

However, a growing concern has emerged about the risk of premature disillusionment with technologies that have significant potential to support the growth and resilience of smallholder farmers. The roundtable explored a proposition that runs counter to current trends. **Limited donor resources dedicated to digital agtech could achieve greater impact if directed toward understanding what smallholder farmers truly need, what they are willing and able to pay for, and how to deliver these solutions sustainably on a commercial basis. Emphasising the scaling of existing solutions, rather than promoting the creation of new startups, could help maximise the value of these investments.**

Key challenges that AgTech startups face

Adoption barriers: The adoption barriers that AgTech startups face are well known (see Appendix 2 for a comprehensive description of these). The discussions focused on three key ones:

1. **Infrastructure, mobile phone ownership, and digital literacy:** AgTechs have to cope with poor connectivity, limited access to smartphones, low literacy, and limited digital exposure among smallholder farmers. Outside Kenya, the digital ecosystem remains limited. Sub-Saharan Africa remains the least connected region. Only 27% of the population uses mobile internet services, which leaves a 13% coverage gap and a 60% usage gap. Furthermore, ownership of mobile phones remains a challenge. In Sub-Saharan Africa, which accounts for a quarter of the unconnected population worldwide, an entry-level device costs 99% of the average monthly income for the poorest 20%. For many, the only access to mobile phones is through shared ownership, with one device shared among all family members. Low levels of digital literacy, and a lack of services or products in local or regional languages also raise the opportunity cost for those considering first-time mobile ownership.

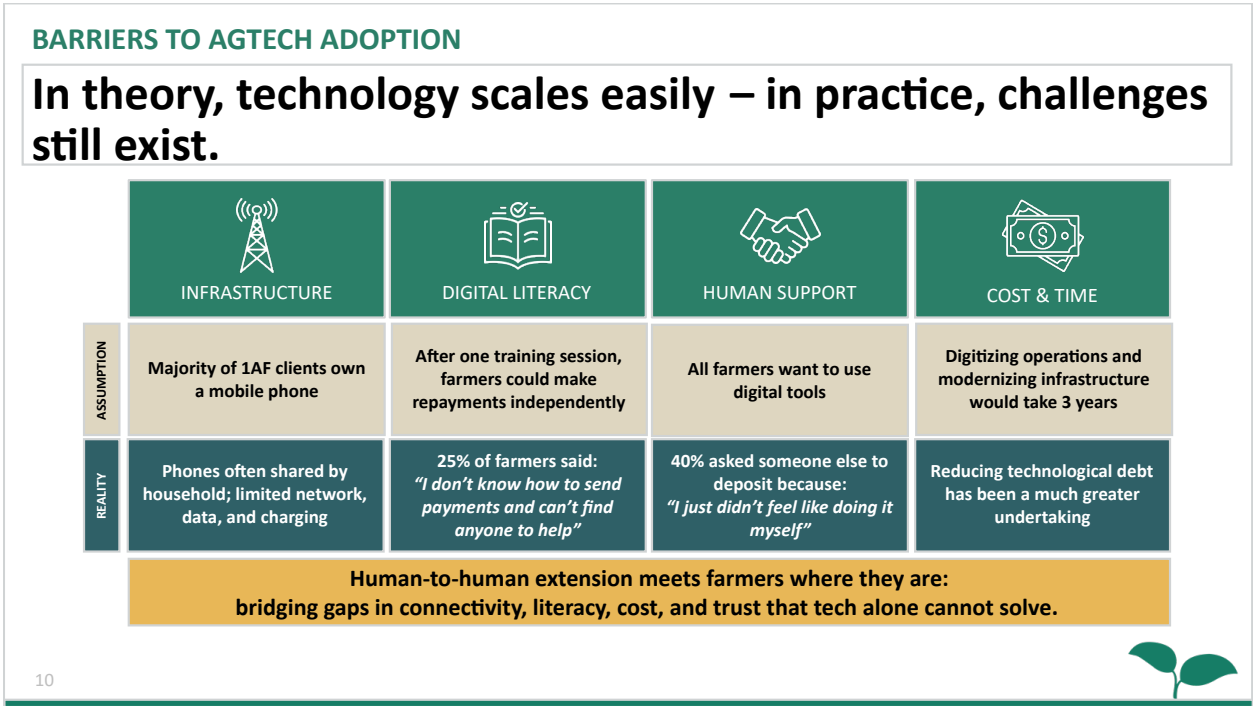


(State of Mobile Connectivity, 2024, GSMA)

2. **Trust and risk aversion:** Farmers are reluctant to adopt unproven technologies of all kinds, due to risk aversion and lack of trust. Syngenta Foundation for Sustainable Agriculture's work with agri-entrepreneurs highlighted how a human agent must demonstrate, educate, and train farmers to help them see the benefits of innovation and make decisions to invest scarce

savings or take loans. The Global Agri-Entrepreneurship Academy (GAEA) is a catalytic platform that supports this work. J-PAL released interesting work on why we need to organize in-person and bundled services for efficiency and optimization of cost-to-impact through digital technologies.

Outside of Kenya, One Acre Fund has struggled to scale its direct-to-farmer app due to a combination of the challenges highlighted above. Adoption and scaling of the Tupande app in Kenya have progressed well, largely due to the foundational elements of tech adoption and smartphone penetration among their client base.



(One Acre Fund)

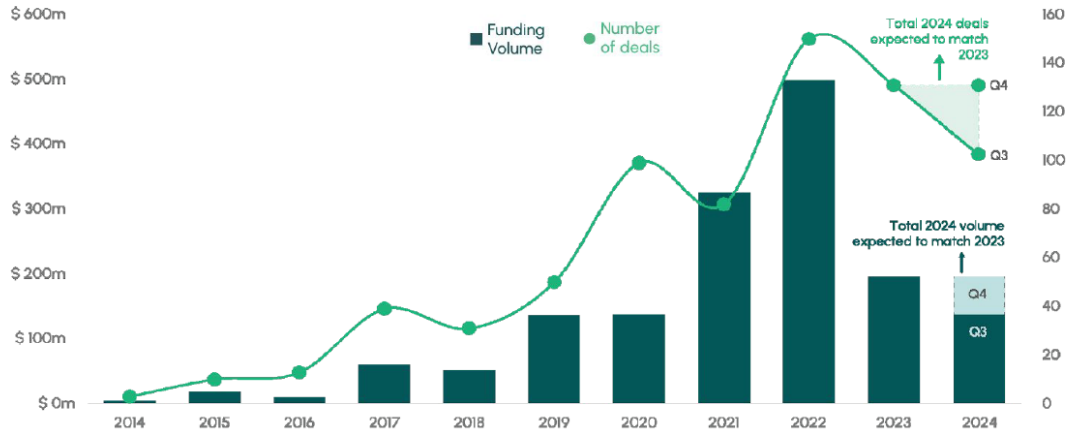
3. **Affordability:** The cost of AgTech solutions, such as software, hardware, and service-based solutions, is a major concern for farmers. High initial investments for technologies are often prohibitive, despite potentially lower lifetime costs compared to current alternatives. For example, the upfront costs for solar irrigation are typically higher than those of equivalent diesel pumps. While the average entry-level diesel pump starts at USD 200 compared to approximately USD 600 to 800 for a solar equivalent, solar water pumps have lower lifetime costs. For example, in a typical farm in Kenya, the total cost to irrigate one acre for more than five years with a solar pump is estimated at USD 3,000 compared to USD 6,000 when using an equivalent diesel pump.

Funding gaps: Funds are key to the scaling of AgTechs and present a particular challenge to them.

- **Declining commercial investment:** Earlier this year, Briter released the AgTech in Africa Investment Report, which highlighted how the sector that experienced a decade of growth with more than USD 1 billion in venture funding now faces contraction. Annual funding has dropped from USD 500 million to just USD 200 million, which marks a 60% decline.

Funding flows | Funding to agribusinesses has fallen off following a rapid growth in funding in 2021 and 2022, but has stabilised around a new baseline.

Figure 3: Funding volume and number of deals to agriculture startups and SMEs in Africa since (2014 - Q3 2024)

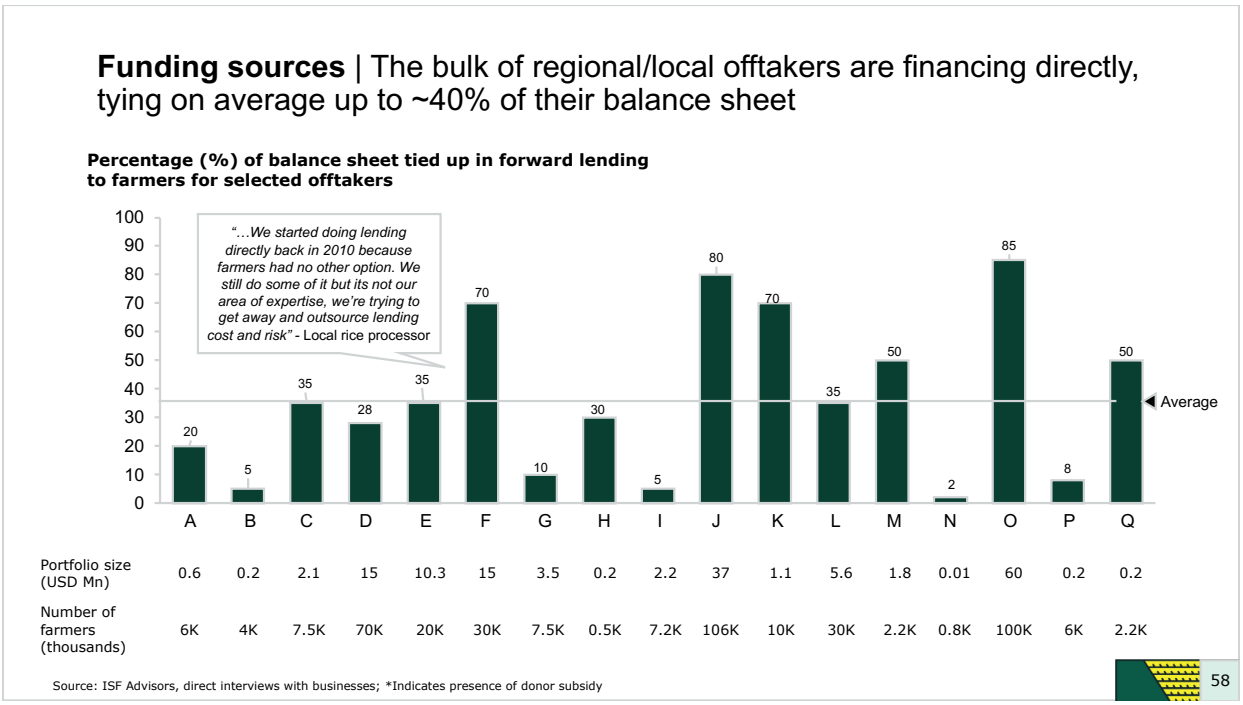


Source: Briter Intelligence, AgBase 2024

(Briter Intelligence)

Commercial investors, who once drove nearly 60% of AgTech deals, now account for just a third. This share will reduce to 25% of total AgTech deals in 2025. The commercial funding stack is also overly complicated and needs simplification. Meanwhile, concessional funders, such as USAID, the BMZ, SIDA, and FCDO, which have played a crucial stopgap role directly and as limited partners in commercial funds, are also scaling back their support. Grant funding will also reduce.

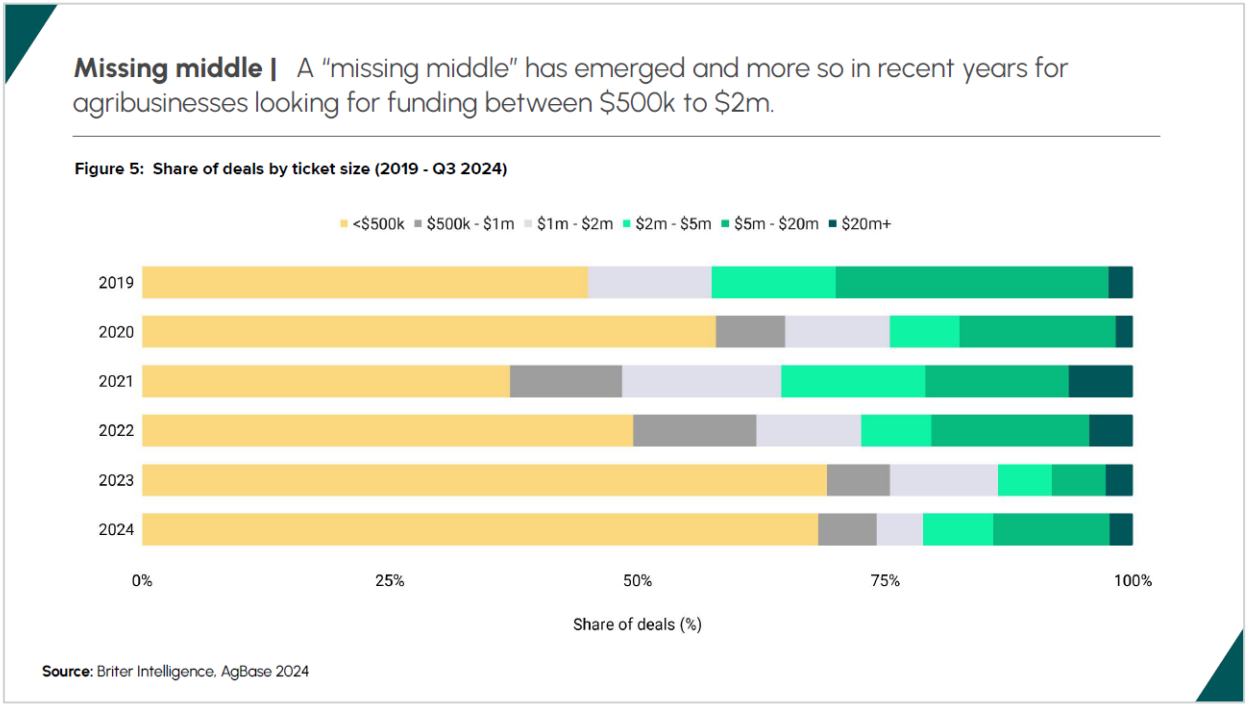
Commercial investors will seek to serve B2B markets on agricultural value chains to gain an easier route to commercial viability. For example, as ISF Advisors note, off-takers are the biggest lenders to smallholders today. They represent one of the most accessible, affordable, and financially sustainable options to finance farmers' upfront investments in AgTech solutions. Most off-takers are willing and have the capacity to scale up their lending activities if they can access affordable capital to meet their financing and associated working capital needs and manage risk. However, we need to take a nuanced and context-specific approach to each market.



(ISF Advisors)

- **Missing middle:** The funding shortfall is most severe in the USD 500,000 to USD 1,000,000 range, where startups face major hurdles to transition from early commercialization to scale. Concessional funders, constrained by their own internal limitations, often struggle to support deals at this stage. While these funders remain active above USD 2,000,000, this is not always where their capital delivers the greatest catalytic impact.

  In some cases, these funders may inadvertently compete with, rather than unlock, commercial investment. This competition makes it tougher to navigate the valley of death. Many startups with high potential fail to scale due to inconsistent funding and a lack of patient capital. They may also simply waste precious executive time chasing funds to follow initial startup grants or angel equity investments. Due to the seasonality of agricultural value chains, typical VC or PE cycles need to adapt to the slower, less frequent product iteration and evaluation cycles of AgTech solutions.



(Briter Intelligence)

Systemic issues:

- **Misaligned solutions**: AgTech solutions are often driven by supply-side push or subsidies rather than the real needs of farmers. It is essential to address and lead with the problems of the farmers. Often, agribusiness models are also not scalable as a function of their core design. Grants and subsidies often focus on ways to reach the most underserved populations. For example, women farmers in remote locations would be a priority. Grants do not often allow entrepreneurs to focus on commercially viable target markets.

  AgTechs may initially focus on more commercial markets to grow their businesses and then be incentivized to extend their models to the underserved. AgTechs need to strike the right balance between localization, to meet the needs of farmer sub-segments, and scale for sustainability.

- **Policy and market constraints**: Weak public extension systems and fragmented markets limit scale. AgTech requires both scale and customized localization, so that the apparent benefits of a standardized and scaled system are often limited by the regulations, policies, languages, and dialects of different countries and regions.

- **Unsuitable subsidies**: Government and donor subsidies need to be "smart" so that they do not create perverse incentives or market distortions. For example, as discussed by the Shell Foundation, subsidies can be used to encourage the adoption of solar technology, as is being done in Uganda. However, such subsidies must be withdrawn on a gently declining basis and within a specified timeframe, so that demand persists and does not disappear in the face of massive price increases as the subsidy lapses.

Lessons from success stories and emerging models

Successful case studies in Africa:

- **Pula:** Pula offers comprehensive insurance that helps more than 19 million smallholder farmers in 12 countries. This supports them in climate risk management through historical benchmark yields that trigger timely payouts when adverse events affect harvests. This enables farmers to invest with confidence and strengthen their long-term resilience.
- **One Acre Fund:** The fund serves 5.5 million smallholder farmers who grow staple crops on less than one acre of land in nine countries. It reported a 40% increase in farmers' incomes through its services as of June 2025. One Acre uses a blended finance model, relies on some grants, achieves scale by bundling services, such as inputs, training, finance, and market access, and deploys human extension agents.
- **Tulaa:** Tulaa partners with farmer-trusted agro-vets to connect suppliers, financial institutions, and farmers based on an understanding of customer sub-segments. It maintains a strong culture of organizational commitment to its vision. Tulaa uses data science to gain deeper insights into customer needs and behaviors, and develops user-friendly interfaces to simplify navigation. It secured early corporate partnerships with off-takers.

  Tulaa served 30,000 borrowers, with 60% new-to-credit borrowers, before COVID-19 halted its business in 2020. An important lesson learned was the benefit of embracing grants and blended or concessional capital early on, rather than focusing primarily on VC funding.
- **HiveOnline:** HiveOnline delivers trusted data and relationships to rural communities in savings groups and cooperatives and facilitates their access to financial services, agricultural inputs, and market buyers. It takes a comprehensive approach to farmer growth, as many of the elements needed are interlinked and benefit from the same underlying data, relationships, and payments. HiveOnline serves thousands of farmers in Kenya, Mozambique, and Ghana.
- **Sutti (by Ksapa):** Sutti seeks to improve agricultural value chains through training, traceability, and support for smallholder farmers. Combines in-person and digital solutions to boost worker training and monitor impact. Sutti builds on multistakeholder coalitions and gathers governments, corporates, financial institutions, researchers, NGOs, solutions providers, such as IREN AGRI initiative codeveloped by Ksapa & Société Générale in Africa. The program has reached more than 100,000 beneficiaries across multiple countries who report increased incomes of 40-80%.

Successful case studies in Asia:

- **Bihar Krishi:** Bihar Krishi is built on India's AgriStack digital public infrastructure (DPI), which reduces costs and promotes competition through shared access to farmer data. Bihar Krishi has registered more than 600,000 farmers in less than a year. MSC designed the platform as an open-source platform so users can adopt and customize with ease. It provides access to government subsidies, weather forecasts, input and output markets, information and advisory services, price discovery, and other services that help deliver an impressive usage rate.
- **DeHaat:** DeHaat offers an online marketplace that provides a comprehensive range of agricultural products and services to farmers. It operates in 12 Indian states with a network of more than 11,000 DeHaat centers and 503 farmer-producer organizations, which serve 1.8 million farmers. DeHaat also provides AI-enabled crop advisory to farmers for more than 30 crops in regional languages.

Key takeaways:

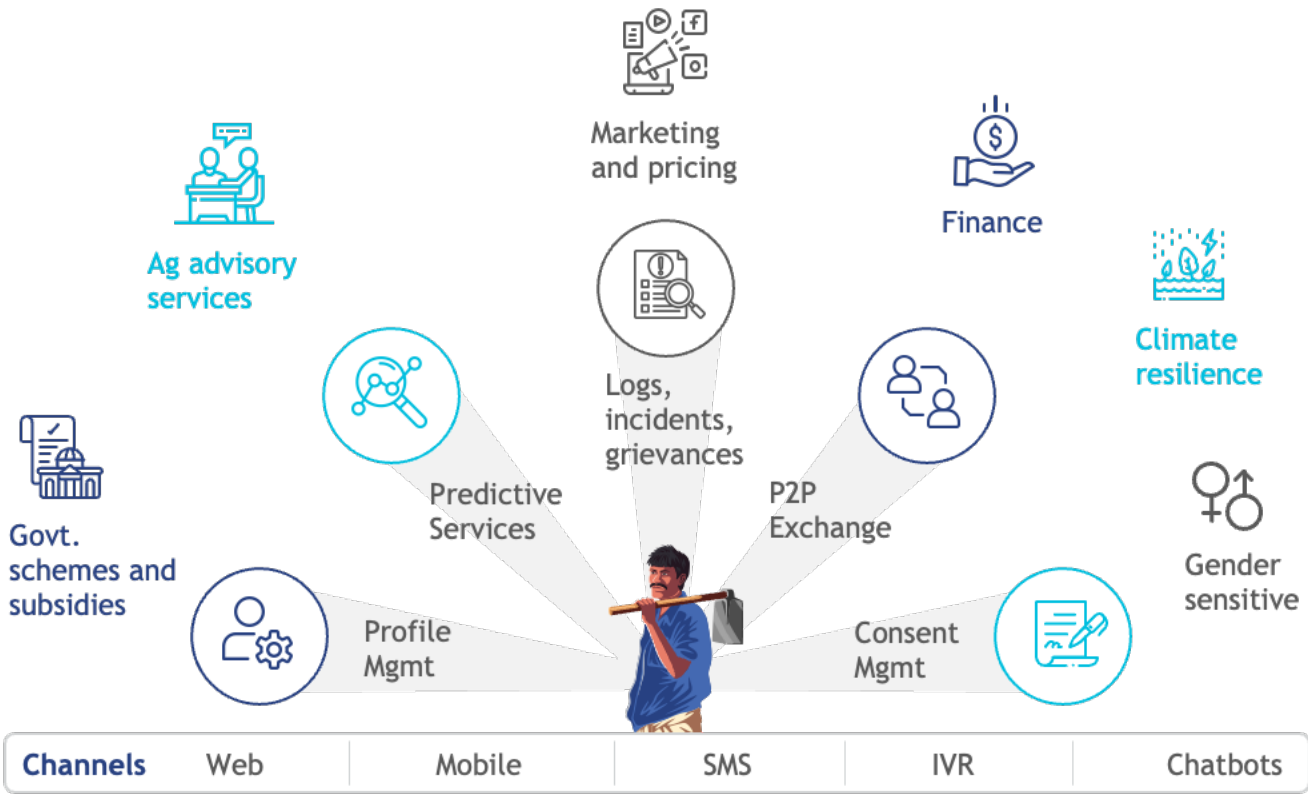
Human-centered design (HCD) places the farmer's needs at the core of product design from the outset, which is key to uptake and usage. It emphasizes simplicity, addresses digital illiteracy, enhances user navigation, and drives behavioral change for users and farmers. Low-tech digital tools, speech recognition, vernacular language, text-to-speech interfaces, and phygital solutions that combine digital tools with human touch have proven highly effective. This approach was instrumental to the success of all the exemplar and scaled AgTech discussed at the roundtable.

Agents are also key to trust-building and adoption. The assisted mode of Bihar Krishi has significantly enhanced uptake and usage, particularly among less affluent and literate farmers, who also include women. Technology can improve the efficiency of field agents, as shown by One Acre Fund's FieldSmart App. Agents can play a critical role in responding to many challenges, such as access, digital literacy, trust, and even affordability. One model, exemplified by the Agri-entrepreneur model, allows agents to offer various products and services for a range of specialized providers or AgTechs, which reduces the costs of service and increases agent income. Additionally, identified farmers who can play the role of "digital champions" and help other members of their cohort use the digital solution and help with data collection for impact monitoring have worked for the KSAPA Sutti programs.

Digital public infrastructure (DPI) can serve as the foundational investment that reduces key and persistent costs across system development and IT infrastructure capital, operations, maintenance, and acquisition, which enhances scalability. AgriStack includes key information on farmer identity, landholding, and crops sown. Providers in the government and private sector can share this information through suitable data security and user consent mechanisms. This allows service providers to avoid duplication, reduce costs, and focus on product design and service delivery, which support innovation, competition, and diverse options for farmers.

DPI strengthens the business case for services to smallholders while it distributes financing needs across the ecosystem by reducing development, customer acquisition, and fulfillment costs for providers. The Bihar Krishi digital farmers' services (DFS) platform shows how this approach delivers a full suite of services to smallholder farmers through multiple channels.

DFS unifies services of government and service providers, offering them through diverse channels in self-service and assisted modes (phygital and AI supported)



However, solutions must also recognize the substantial differences in digital evolution across geographies, especially between India and Asia on one side and Sub-Saharan Africa on the other. These differences extend to varied government roles and involvement as they address market inefficiencies or failures.

Blended finance and patient capital help bridge the "valley of death." Few organizations provide funds of around USD 500,000 to USD 1 million, which leaves a massive "missing middle" and a graveyard for promising AgTech startups. The lack of suitable capital in the early stages and through the "valley of death" has proven fatal for many AgTechs.

Emerald Africa's debt facility is among the few funds that offer startups a path to larger commercial funds. AgDevCo similarly uses blended finance to provide long-term debt and equity investments that help build farming and agri-processing companies that can deliver impact at scale. Investments from FCDO, BII, NorFund, and SwedFund have allowed AgDevCo to de-risk and crowd in private capital, which has led to a portfolio of USD 370 million invested in 40 brick-and-mortar companies in 11 countries that support 12.8 million farmers. This provides a strong response to the Financial Times' assertion of "The wasted potential of 'blended finance'" in agriculture.

Partnerships are crucial and enable AgTechs to use complementary expertise, apply lessons learned rapidly, and avoid unnecessary duplication. Partnerships can take various forms, such as early

engagements with corporates or off-takers, public-private partnerships, distribution channels, and financial institutions. For instance, Tulaa's early corporate partnerships with off-takers, such as Yara fertilizers, significantly enhanced their market access and operational capabilities.

Similarly, KSAPA's collaborations with corporates, such as Michelin and their Tier 1 suppliers, government agencies, and farmer cooperatives, have strengthened farmer outreach and adoption in Indonesia and Sri Lanka, which contributes to sustainable agricultural practices. Additionally, partnerships with large corporations, such as Syngenta, have provided crucial support to build market connections effectively and highlight the importance of strategic alliances.

Additionally, greater collaboration and convergence are essential at multiple levels. Donors and funders should align their goals and strategies and collaborate to achieve enhanced efficiency and impact. Governments must respond proactively when market failures occur. Subsidies, grants, and concessional capital require redesign and retooling, with better alignment to address market inefficiencies across humanitarian to commercial needs. These outcomes demand significantly strengthened collaboration among all stakeholders.

AI can potentially transform agriculture when customized to local contexts. Yet significant development work remains. Image-based AI, such as Plantix, already provides a sense of feasibility, as many crop diseases manifest in a similar way, irrespective of locality. Location-specific AI chatbots for farmer advisory are under development for Bihar Krishi, yet the prevalence of regional languages and the scarcity of suitable training datasets present challenges. AI solutions must address five core challenges of affordability, availability, acceptability, accuracy, and security.

Policymakers and regulators must develop farmer-centric data governance guidelines that implement fair and equitable data governance models, prioritize farmer participation, and guard farmers against disadvantages and exploitation. The digital infrastructure limitations and lack of data to train LLMs in SSA as mentioned already are barriers for effective AgriTech-focused AI in SSA.

Improved digital literacy through the use of low-tech services in the meantime will help bridge the gap towards access to AI or other advanced technologies as some of these barriers start to lower.

Appendix 1

Roundtable participants:

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Appendix 2

3x5 commonly cited factors underlying the lack of uptake and usage of digital technologies:

Technological factors:

1. **Perceived utility and observability:** Farmers are more likely to adopt a technology when they observe its usefulness in the field.
2. **Adaptability:** Technologies must be adaptable to local conditions, which ensures compatibility and increases farmers' perception of utility.
3. **Demonstrated satisfaction:** Farmers are influenced by the satisfaction of others who have adopted the technology, build trust, and enhance adoption probabilities.
4. **Trialability:** Prospective users should have the opportunity to experiment on a limited scale before full commitment, which showcases the technology's practicality and expands adoption.
5. **Ease of ease (complexity):** Adoption is facilitated when technologies are user-friendly, which minimizes complexity and ensures a smoother integration into existing practices.

Socio-economic and demographic factors:

1. **Farm size:** Large-scale farmers are more inclined to adopt technological advancements due to economies of scale and lower risk aversion. They are also much more likely to adopt high-risk, high-reward technological solutions.
2. **Education level:** Higher education levels among farmers correlate with increased adoption rates, especially for sophisticated technologies that require learning.
3. **Risk attitude:** Limited resources and high uncertainty make farmers risk-averse; early adoption is driven by risk-takers who seek higher profits. While new technologies can boost profits, uncertainty about their performance makes risk-averse farmers wait until others use them to prove their effectiveness, thereby slowing the diffusion process.
4. **Gender:** Technology adoption is associated more with access to resources than with gender. Men often have better access due to socio-cultural norms, which makes them the primary decision-makers in households.
5. **Age:** Younger farmers are more open to new technologies and make decisions based on long-term considerations. Older farmers exhibit lower adoption rates, are more risk-averse, and are less likely to experiment with novel approaches or be swayed by potential benefits.

Institutional factors:

1. **Membership of an organization:** Farmers in social groups or cooperatives adopt technology at higher rates, which benefits from pooled resources, access to training, shared information, and peer influence.

2. **Access to extension services:** Extension agents help facilitate technology adoption through resources, information, training, and lower the learning curve. Crucially, they establish trust in the technology
3. **Access to credit:** Credit access increases the probability of technology adoption because it increases liquidity constraints and enhances the capacity to bear risk.
4. **Market distance:** Farmers far from markets face challenges to access inputs and resources, which affects productivity and motivation while they adopt new technologies. The geographical barriers also disrupt the flow of information in innovative technologies and their market prospects.
5. **Access to information:** Information access, from reliable sources, empowers farmers to discover and understand new technologies, which reduces uncertainty and drives adoption.

The SHF's aspirations and plans further moderate all these factors. Dorward (2009) highlighted three basic typologies:

- "Hanging in," farmers maintain current levels of wealth and welfare, in the face of the threats of stress and shocks;
- "Stepping up," farmers make investments to increase production and income through intensification, diversification, and/or expansion;
- "Stepping out," farmers accumulate assets, which enable them to move into different activities that lead to higher and/or more stable returns. This often involves increased off-farm employment or an exit from agriculture.


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