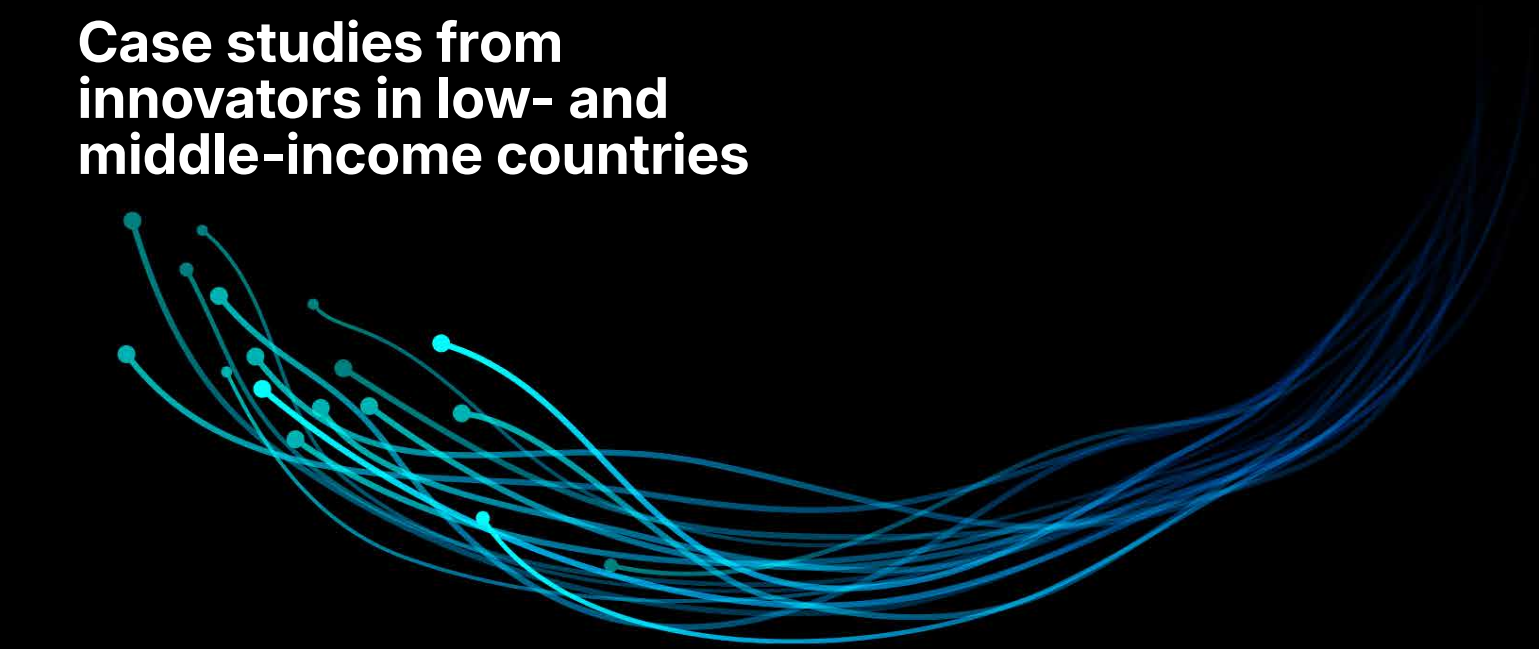
GSMA
Mobile for Development

AI FOR IMPACT AT SCALE

Case studies from innovators in low- and middle-income countries



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 EmergingTech Programme

The GSMA EmergingTech programme accelerates impact and climate action by fostering the adoption of AI and emerging technologies in low- and middle-income countries (LMICs) by working with public, private and third sector innovators to develop scalable and sustainable solutions that have inclusive and responsible AI at the core. The Emerging Tech programme works closely with the GSMA AI for Impact initiative to drive real-world, impact-focused implementation with telcos in LMICs.

To get in touch with the Emerging Tech team, please email: emergingtech@gsma.com

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Dalberg

The report has been produced in partnership with Dalberg Advisors, a strategic advisory firm that works collaboratively across the public, private and philanthropic sectors to drive inclusive and sustainable growth. The firm has 29 locations and has served clients in more than 135 countries. The Dalberg team behind this report includes Nick Whalley, Annette Chau and Felina Lottner.

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CONTENTS

ACRONYMS AND ABBREVIATIONS

AGCC	Africa Green Compute Coalition
AI	Artificial Intelligence
ANC	Antenatal Care
ANM	Auxiliary Nurse-Midwife
API	Application Programming Interface
APP	Asian Preparedness Partnership
ASHA	Accredited Social Health Activist
AWW	Anganwadi Worker
AWS	Amazon Web Services
B2B	Business-to-Business
B2B2C	Business-to-Business-to-Consumer
B2C	Business-to-Consumer
B2G	Business-to-Government
BNPL	Buy Now Pay Later
CaaS	Cognition as a Service
C&I	Commercial and Industrial
CGIAR	Consultative Group on International Agricultural Research
CHIP	Community Health Integrated Platform
CHW	Community Health Worker
CIFF	Children's Investment Fund Foundation
CSO	Civil Society Organisation
CSR	Corporate Social Responsibility
DPG	Digital Public Good
DHIS2	District Health Information Software 2
DPI	Digital Public Infrastructure
EmONC	Emergency Obstetric and Newborn Care
EMF	Electromagnetic Flow Meter
ERW	Enhanced Rock Weathering
FAO	Food and Agriculture Organization of the United Nations
FMCG	Fast Moving Consumer Goods
FNMR	False Non-Match Rate
FMR	False Match Rate
FPO	Farmer Producer Organisation
GDP	Gross Domestic Product
GenAI	Generative Artificial Intelligence
GIS	Geographic Information System
GPT	Generative Pre-trained Transformer
GPU	Graphic Processing Unit
H2R	Hardest-to-Reach (Acumen initiative)
HCD	Human-Centred Design
HITL	Human in the Loop
HMS	Health Management System
ID	Identity Document
IoT	Internet of Things
IVR	Interactive Voice Response
KALRO	Kenya Agricultural and Livestock Research Organization
KSL	Kenyan Sign Language
LLM	Large Language Model
LMIC	Low- and Middle-Income Country
MCP	Model Context Protocol
ML	Machine Learning
MNO	Mobile Network Operator
MRV	Measurement, Reporting and Verification
MSME	Micro, Small and Medium-sized Enterprise
NCD	Noncommunicable Disease
NGO	Non-Governmental Organisation
NLP	Natural Language Processing
NRW	Non-Revenue Water
OCR	Optical Character Recognition
OECD	Organisation for Economic Co-operation and Development
PAYG	Pay As You Go
PNC	Postnatal Care

PPA	Power Purchase Agreement
PRISM	Power Resilience and Intelligent System Management
PROMPTS	Promoting Mothers and Pregnant Women Through SMS
R&D	Research and Development
RAG	Retrieval-Augmented Generation
RMNCAH	Reproductive Maternal Newborn Child and Adolescent Health
SaaS	Software as a Service
SDGs	Sustainable Development Goals
SIM	Subscriber Identity Module
SLM	Small Language Model
SME	Small and Medium-sized Enterprise
SMS	Short Message Service
STT	Speech To Text
TB	Tuberculosis
ToT	Training of Trainers
TTS	Text To Speech
TPIR	True Positive Identification Rate
UCIF	United Capital Infrastructure Fund
UNDP	United Nations Development Programme
USSD	Unstructured Supplementary Service Data
VC	Venture Capital
VPP	Virtual Power Plant
VWBA	Volumetric Water Benefit Accounting

DEFINITIONS

Agroforestry	A collective term for land management systems where woody perennials (trees, shrubs, palms, bamboo, etc.) are deliberately integrated with agricultural crops and/or animals in some form of spatial arrangement or temporal sequence.[1]
AI for development	We use this term to refer to the use of AI and its applications with the potential to address development challenges in low- and middle-income countries (LMICs).
Algorithm	A process or set of rules to be followed in calculations, especially by a computer, to solve a problem.
Application programming interface (API)	A set of rules or protocols that enables software applications to communicate with each other to exchange data, features and functionality.[2]
Artificial intelligence	Artificial intelligence (AI) is comprised of widely different technologies that can be broadly defined as "self-learning, adaptive systems."[3] AI has the capability to understand language, solve problems, recognise pictures and learn by analysing patterns in large sets of data.
Big Tech	In this report, Big Tech players refer to the large tech companies known globally, including Google, Microsoft, IBM, Meta and Amazon. The terms "Big Tech" and "large tech companies" are used interchangeably in some contexts.
Biochar	A form of charcoal created by heating organic material (biomass) in an environment without oxygen at high temperatures. A primary application of biochar is its use as a soil amendment to improve soil functions and reduce emissions from biomass that would otherwise naturally degrade to greenhouse gases.[4]
Blockchain	A digital ledger technology that records transactions securely and transparently, often used for traceability and verification.[5]
Carbon sequestration	The process of capturing carbon dioxide from the atmosphere and storing it in a stable form to mitigate climate change.[6]
Compute	The process of performing calculations or computations required for a specific task, such as training an AI model. It also encompasses the hardware components, like chips, that carry out these calculations, as well as the integrated hardware and software systems used to perform computing tasks.[7]

1. Definition by the Food and Agriculture Organization of the United Nations (FAO).
2. Definition by IBM.
3. Definition by the International Telecommunication Union (ITU).
4. Definition derived from Biochar International.
5. Definition by IBM.
6. Definition by USGS.
7. AI Now Institute. (2023). *Computational Power and AI*.

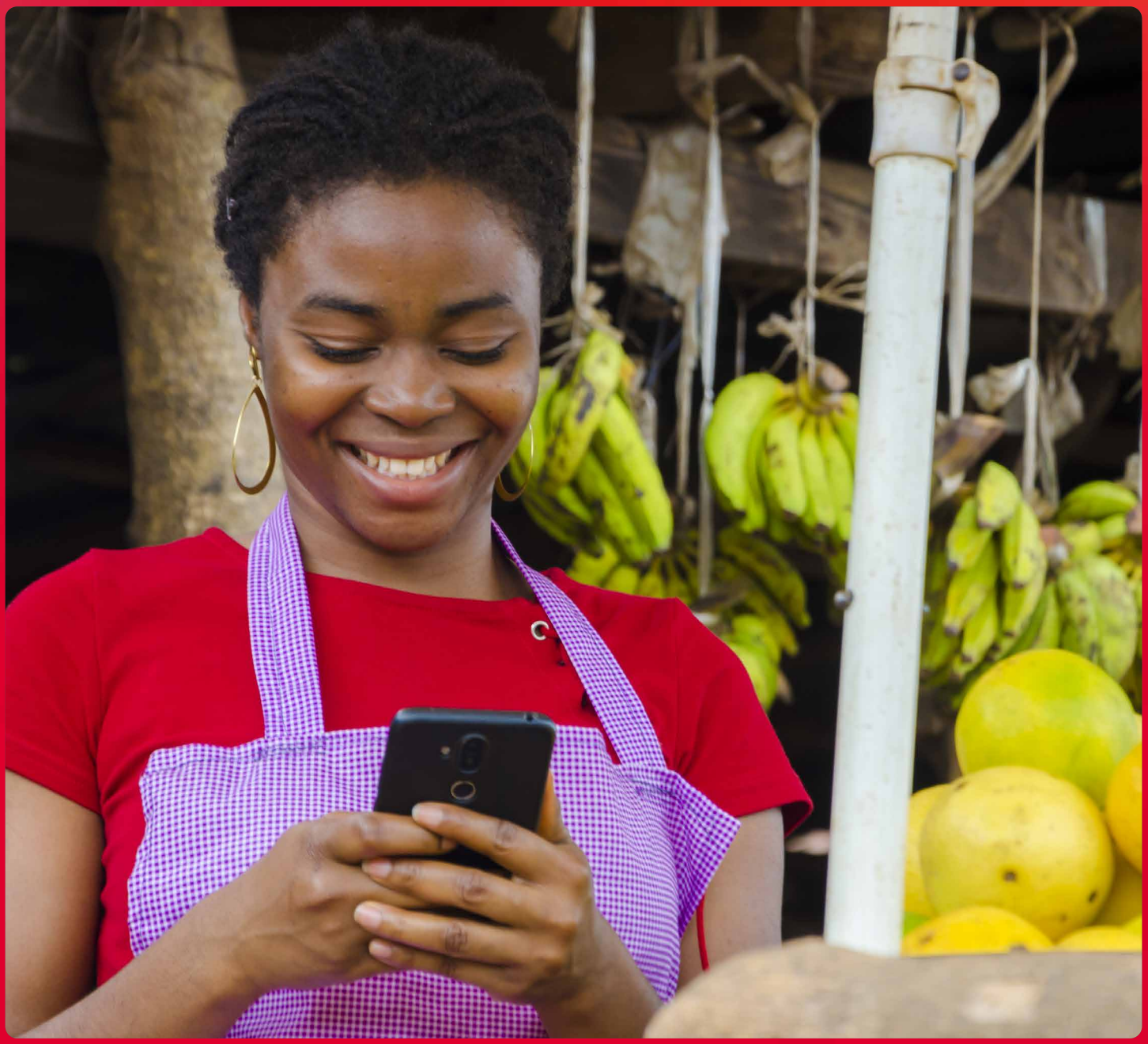
Computer vision	A type of AI that enables computers and other machines to identify and interpret visual inputs from images and videos.[8]
Digital public good (DPG)	Open-source software, data, AI models, standards and content that adhere to privacy and other applicable laws and best practices to do no harm and help attain the Sustainable Development Goals (SDGs).[9]
Digital public infrastructure (DPI)	Foundational, re-usable digital building blocks, such as digital payments, ID and data sharing, designed for the public benefit.[10]
Digital twin	A virtual representation of an object or system that spans its life cycle, is updated from real-time data and uses simulation, machine learning and reasoning to aid decision-making.[11]
Generative AI (GenAI)	A type of AI that involves generating new data or content, including text, images or videos, based on user prompts and by learning from existing data patterns.
Human-in-the-loop (HITL)	A system or process in which a human actively participates in the operation, supervision, or decision-making of an automated system.[12]
Internet of Things (IoT)	A network of physical devices embedded with sensors and software to connect and exchange data over the internet.[13]
Large language model (LLM)	AI models trained on vast amounts of text data to understand and generate human-like language.[14]
Machine learning (ML)	A subfield of AI, broadly defined as the capability of a machine to imitate intelligent human behaviour and learn from data without being explicitly programmed.[15]
Measurement, reporting and verification (MRV)	Procedures and technologies used to accurately quantify, track and validate the climate impact of projects.[16]
Natural language processing (NLP)	A field of machine learning in which machines learn to understand natural language as spoken and written by humans, instead of the data and numbers normally used to program computers.
Non-revenue water (NRW)	The volume of water that is produced or enters the water distribution system but does not generate revenue, because it is lost, not billed, or not paid by customers.[17]

8. Definition taken from Microsoft Azure's dictionary on cloud computing.
9. Definition by Digital Public Goods.
10. Definition by Gates Foundation.
11. Definition by IBM.
12. Definition by IBM.
13. Definition by IBM.
14. Definition by IBM.
15. Definition by the MIT Sloan School of Management, based on the definition by AI pioneer Arthur Samuel.
16. Definition derived from UNFCCC.
17. Definition derived from the World Bank.

Optical character recognition (OCR)	Technology that converts images of text into machine-readable format.[18]
Predictive AI	A type of AI that uses statistical analysis and machine learning algorithms to make predictions about potential future outcomes, identify causation and assess risks.[19]
Prescriptive AI	AI that analyses potential actions and recommends or directly executes the optimal next steps needed to achieve specific goals.[20]
Remote sensing	Acquiring information from a distance via remote sensors on satellites, aircrafts and drones that detect and record reflected or emitted energy. All objects on Earth reflect, absorb or transmit energy, with the amount varying by wavelength. Researchers can use this information to identify different Earth features as well as different rock and mineral types.[21]
Retrieval-augmented generation (RAG)	An architecture for optimising the performance of an AI model by connecting it with external knowledge bases.[22]
Software as a service (SaaS)	A cloud-based software delivery model in which providers host applications and make them available to users over the internet.[23]
Small language model (SLM)	Smaller, more efficient language models designed for specific tasks or resource-constrained environments.[24]
Synthetic data	Artificial data designed to mimic real-world data, generated through statistical methods or AI techniques like deep learning and GenAI.[25]

18. Definition by IBM.
19. Definition from the Carnegie Council for Ethics in International Affairs.
20. Definition by IBM.
21. Definition by NASA Earthdata.
22. Definition by IBM.
23. Definition by IBM.
24. Definition derived from IBM.
25. Definition by IBM.

EXECUTIVE SUMMARY



Artificial intelligence (AI) is rapidly evolving from promise to practice in low- and middle-income countries (LMICs), with tangible impacts in a range of sectors. From health and education to agriculture and energy, its ability to advance the United Nations Sustainable Development Goals (SDGs) has captured global attention and offers new pathways for inclusive and sustainable growth in resource-constrained settings.

Despite delivering both social and economic benefits, there is still limited understanding of how AI is deployed. This report aims to fill that gap by showcasing innovators that are harnessing the capabilities of AI to address long-standing global development challenges, the technologies enabling these efforts, the business models that are making them sustainable and the challenges they have encountered along the way.

The transformative potential of AI

Across LMICs in Africa, South Asia and Southeast Asia, AI has the potential to address systemic challenges in health, agriculture, climate, energy and economic development.

- In agriculture, AI-driven tools can help mitigate undernutrition by increasing agricultural yields and detecting pest infestations before crops are destroyed. AI-driven advisory tools and platforms like FarmerChat[26] are improving the speed and efficiency of agricultural extension by delivering on-demand, real-time, personalised and climate-smart advisory services through interactions between farmers, extension workers and implementing partners.
- In healthcare, AI can alleviate severe shortages of trained medical staff through telemedicine and diagnostic support, improving access to care for millions. AI-powered solutions such as PROMPTS[27] and Khushi Baby[28] are improving maternal and child health outcomes, enabling personalised support and strengthening public health systems.
- In climate action, companies like Varaha[29] are enabling smallholder farmers to participate in high-integrity carbon markets, using AI and emerging technologies to streamline onboarding, automate verification and improve traceability.
- In digital inclusion, assistive technologies like Kibo[30] are using a suite of AI-powered tools to enable visually impaired and low-literacy users to digitalise and contextually translate printed and handwritten content into searchable and editable formats, listen to it and create downloadable audio narrations in local languages.

26. FarmerChat by Digital Green.
27. PROMPTS by Jacaranda Health.
28. Khushi Baby.
29. Varaha.
30. Kibo by Trestle Labs.

Scalability and localisation

Solution providers are adapting AI models, data and delivery channels to local contexts to scale up their impact across LMICs. By continuously training AI models with domain- and region-specific datasets, offering services in local languages and adapting service delivery to users' digital literacy levels and preferred communication channels, they are simplifying user engagement and driving the adoption of scalable, impactful AI solutions. For example, FarmerChat by Digital Green, Kibo by Trestle Labs, PROMPTS by Jacaranda Health and ASHABot[31] by Khushi Baby, are all adapting content to local, low-resource languages and offering multimodal interactions, using AI to meet users where they are.

Similarly, &frnds is addressing the practical realities of the informal retail markets of Southeast Asia, using a blend of AI and human workforce to digitalise the distribution of fast-moving consumer goods (FMCG) in the last mile and provide access to trade finance for micro- and small retailers.

AI fundamentals and enabling environments

The adoption of AI in LMICs depends on robust digital infrastructure and affordable computing power. For instance, health tech innovations require integration with public health management systems (HMS) to streamline the delivery of life-saving medical supplies. However, most public health facilities in LMICs lack basic digital infrastructure, making it challenging for health tech innovators to deploy services at scale.

The increasing availability of data from diverse sources, enabled by emerging technologies such as IoT sensors, drones equipped with high-resolution cameras and satellite imagery, along with AI's ability to process large volumes of historical data, is advancing the development of impactful AI use cases. However, in LMICs, innovators often work with noisy and unreliable data – the result of fragmented and weak digital public infrastructure (DPI) – and without interoperable ID systems and health registries, creating inconsistencies that drive up the cost and complexity of data processing. The challenges of unreliable data in resource-constrained settings underscore the need for continued investment in both infrastructure and advanced data-processing capabilities to unlock the full potential of AI in LMICs.

AI innovation in LMICs is still in early stages compared to high-income countries (HICs), and most AI-for-impact business models take longer to see return on investment (ROI) compared to typical commercial ventures. These innovations target underserved and underprivileged populations who cannot afford to pay for the services offered, prompting companies to explore creative business models.

Partnerships are equally important. Effective collaboration between government agencies, Big Tech companies and civil society organisations (CSOs) can amplify outreach and embed AI solutions across different sectors. However, coordination challenges and limited capacities of partner organisations can disrupt project continuity and present obstacles to scale.

This report is aimed at solution providers, including startups, social enterprises and non-profit organisations, that are developing products and services that leverage AI and emerging technologies (e.g. mobile big data, Internet of Things (IoT), remote sensing, computer vision, blockchain and drones) alongside mobile technologies to solve real-world problems. It is also for donors, investors and others who play an important role in supporting the development and scale of impactful AI solutions for underserved populations in LMICs.

This report is the first of a two-part series. The first report showcases examples of AI in action through 12 case studies, while the second will present key lessons and insights from across sectors, use cases and specific solutions.

31. Ramjee, P. et al. (2025). "ASHABot: An LLM-Powered Chatbot to Support the Informational Needs of Community Health Workers". Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems, 698, pp. 1–22.

INTRODUCTION

Over the past few years, AI has become a transformative tool, advancing progress on some of the most pressing global development challenges. AI applications have tremendous potential for social and economic impact, especially in low- and middle-income countries (LMICs) where resources are limited and innovative approaches to inclusive and sustainable development are needed most.

With 84% of adults in LMICs owning a mobile phone, three-quarters of which are smartphones,[32] widespread mobile access is enabling the adoption of AI. Advances in AI capabilities are converging with the rise of compact and more efficient models, allowing innovators to design and deploy AI-powered solutions at scale. The cost of inference – the process through which trained AI models recognise patterns and draw conclusions from information they have not seen before – has also dropped significantly. Between November 2022 and October 2024, the inference cost of a system matching GPT-3.5[33] performance fell by more than 280 times. For hardware, annual cost reductions of 30% and energy efficiency gains of 40% are also making AI applications more accessible.[34]

Economically, AI could double Africa's GDP growth rate by 2035,[35] spurring productivity gains across agriculture, healthcare, public services, mining, industry and financial services. In South Asia and Southeast Asia, AI is projected to deliver substantial economic gains by 2030, driven by productivity improvements in manufacturing, services, agriculture and digital commerce. In Southeast Asia, AI could contribute up to USD 950 billion to GDP by 2030, equivalent to a 13% increase, with Indonesia, Vietnam and the Philippines among the biggest beneficiaries.[36] These gains will stem from AI-enabled efficiencies in healthcare, financial services, logistics and climate-smart agriculture, alongside rapid growth in cloud and data ecosystems.

As the transformative potential of AI becomes increasingly evident, it is crucial to understand not just the technological advances, but also how AI can address development challenges. The convergence of widespread mobile connectivity, declining costs of model deployment and infrastructure, and the availability of domain-specific datasets, is creating opportunities for AI to have a meaningful impact in LMICs. Realising this potential, however, depends on sustained investment in digital infrastructure, skills development and enabling policies that promote inclusive and sustainable adoption.

To make sense of this, the following framework (Figure 1) maps out how AI can be used at different points of intervention along the user journey to add value and have an impact in the last mile in LMICs.

32. Zhenwei Qiang, C., Straub, S. and Klapper, L. (15 September 2025). "Digital Technology Is Driving the Future of Jobs". *World Bank Blogs*.

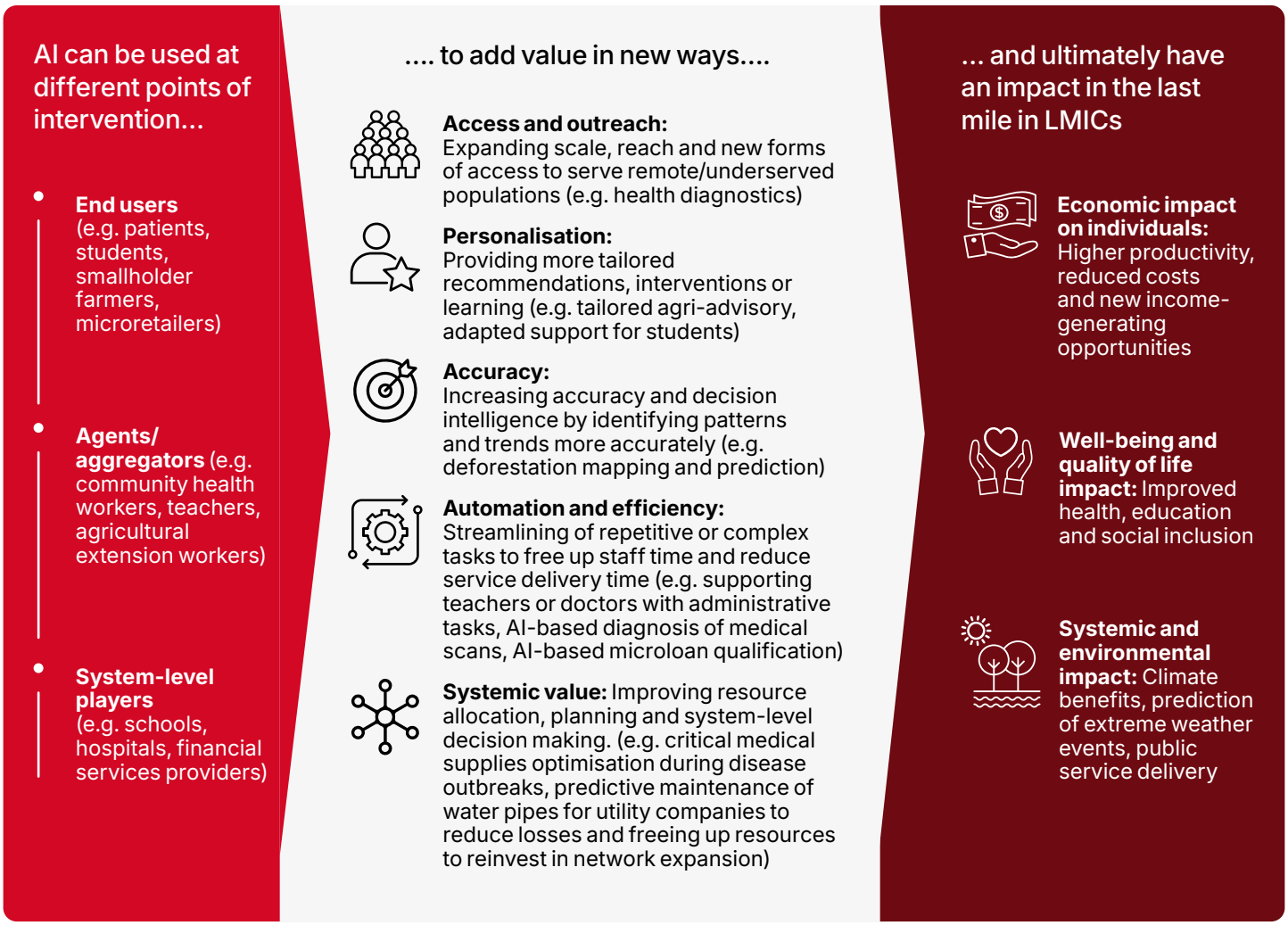
33. Definition by IBM: Generative pretrained transformers (GPTs) are a family of large language models (LLMs) based on a transformer deep learning architecture. Developed by OpenAI, these foundation models power ChatGPT and other GenAI applications capable of simulating human-created output.

34. Stanford University. (2025). *Artificial Intelligence Index Report*.

35. AUDA-NEPAD. (2021). *AI for Africa: Artificial Intelligence for Africa's Socio-Economic Development*.

36. East Ventures. (2025). *AI-first: Decoding Southeast Asia trends*.

Figure 1: The uses, value and last-mile impacts of AI in LMICs



Source: GSMA and Dalberg (2025)

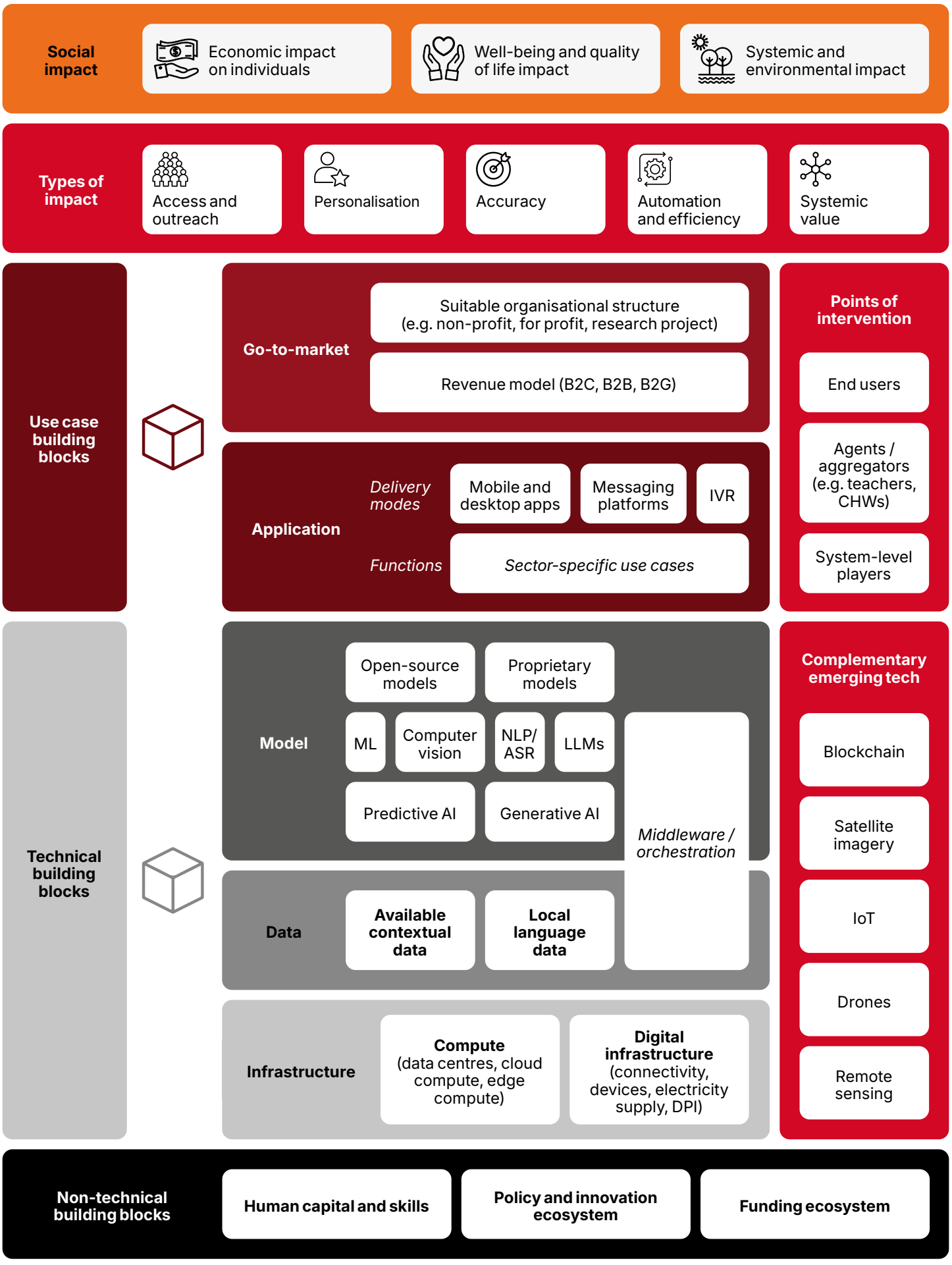
To understand the impact of AI-driven innovative products and services in LMICs, we also provide a framework of the key components – technical, non-technical and use cases – that inform and advance our understanding of these solutions (Figure 2).

This report is aimed at solution providers, including startups, social enterprises and non-profit organisations, that are developing products and services that leverage AI and emerging technologies (e.g. mobile big data, IoT, remote sensing, computer vision, blockchain and drones) alongside mobile technologies to solve real-world problems.

The report is also for ecosystem enablers, primarily donors and investors, who can play an important role in supporting the development and scale of impactful AI solutions for underserved populations in LMICs.

This report is the first in a two-part series. It showcases real-world examples of AI in action through 12 case studies, while the second report will present lessons and insights from across different sectors, use cases and solutions.

Figure 2: Key components of impactful AI solutions in LMICs



Source: GSMA and Dalberg (2025)

Research objectives

This research documented AI-enabled use cases and solutions that address development challenges across sectors. Specifically, the research aimed to:

- Identify and document impact-driven digital solutions that leverage AI alongside mobile technologies to generate data (e.g. mobile big data, IoT, drones) and use AI in combination with other emerging technologies (e.g. blockchain, remote sensing, satellite imagery).
- Evaluate the incremental benefits of AI and emerging technologies for impact-driven digital solutions, with a focus on scalability, business efficiency and service improvements.
- Identify key technological, operational and business-related challenges in deploying emerging technologies for impact-driven AI solutions.
- Determine the types of support required by service providers to implement and scale these innovations successfully.

Methodology

Desk-based research included a literature review of grey literature and industry-specific reports, academic publications, databases of research institutes and multilateral organisations, national digital development policy documents and local news articles.

Semi-structured key informant interviews (KIIs) interviews were conducted with 42 innovators working on AI use cases and with 25 regional and global experts.

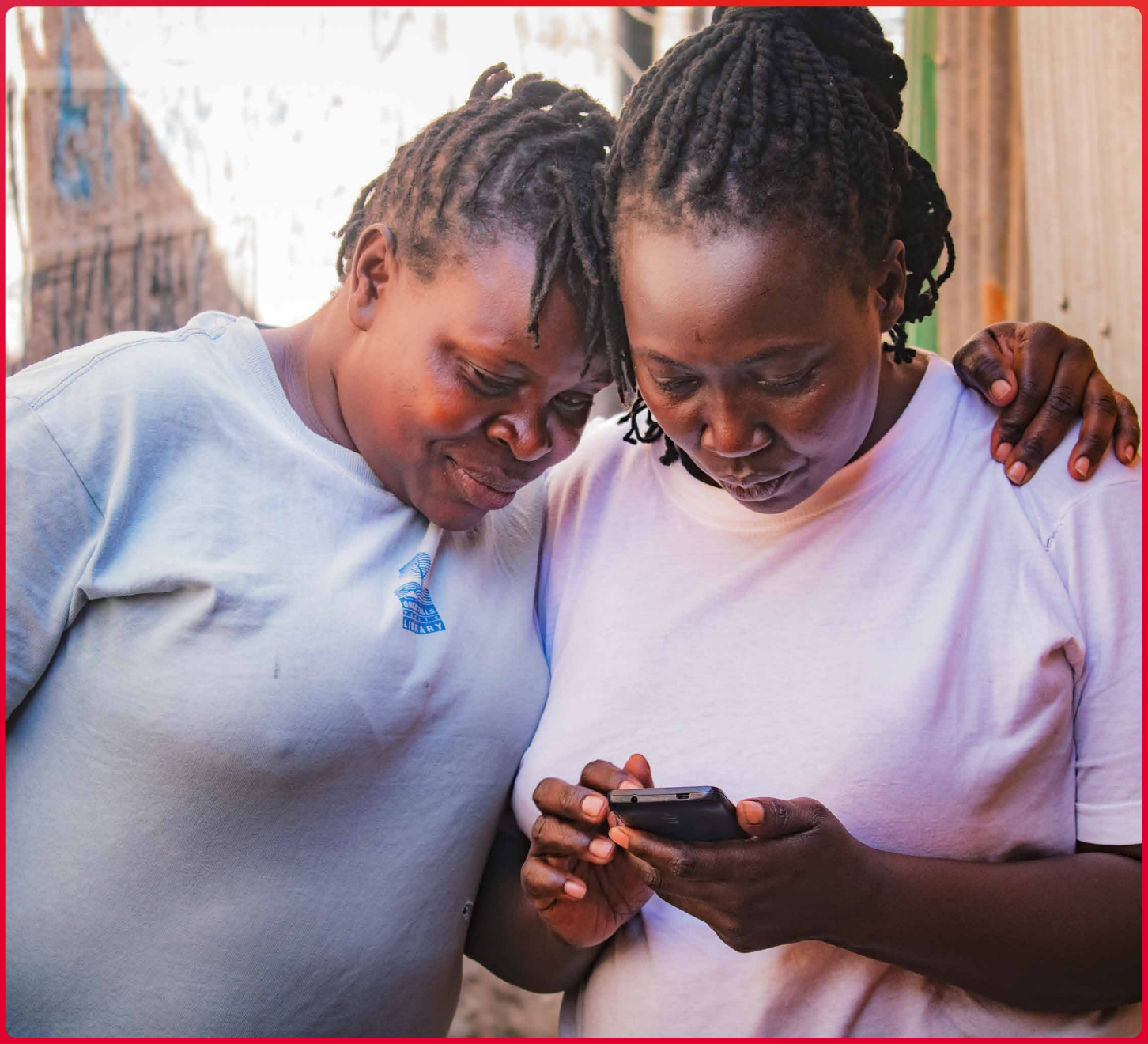
Research scope and limitations

This research examined sector-agnostic, AI-led digital innovations in LMICs across Africa, South Asia and Southeast Asia. The focus was identifying and documenting impact-driven applications of AI in sectors critical to social and economic development in LMICs, including climate action (climatetech), agriculture (agritech), digital inclusion (edtech and assistivetech), digital utilities, humanitarian action, health (healthtech) and financial inclusion (fintech). These sectors play a central role in improving livelihoods, building resilience and driving sustainable growth, making them key areas in which AI can deliver meaningful impact at scale.

The research covers a range of stakeholders developing or deploying AI solutions, including startups, social enterprises, large tech companies, government agencies, NGOs, CSOs and academia. It analyses how these actors use AI in different ways to increase the impact and reach of their products or services, to better understand their customers, to target markets and to streamline their internal operations and processes.

Our analysis of AI use cases is based on a limited sample identified in secondary research and KIIs. The findings do not cover geographic and ecosystem-level requirements, barriers, policy or ethical considerations.

AI FOR IMPACT

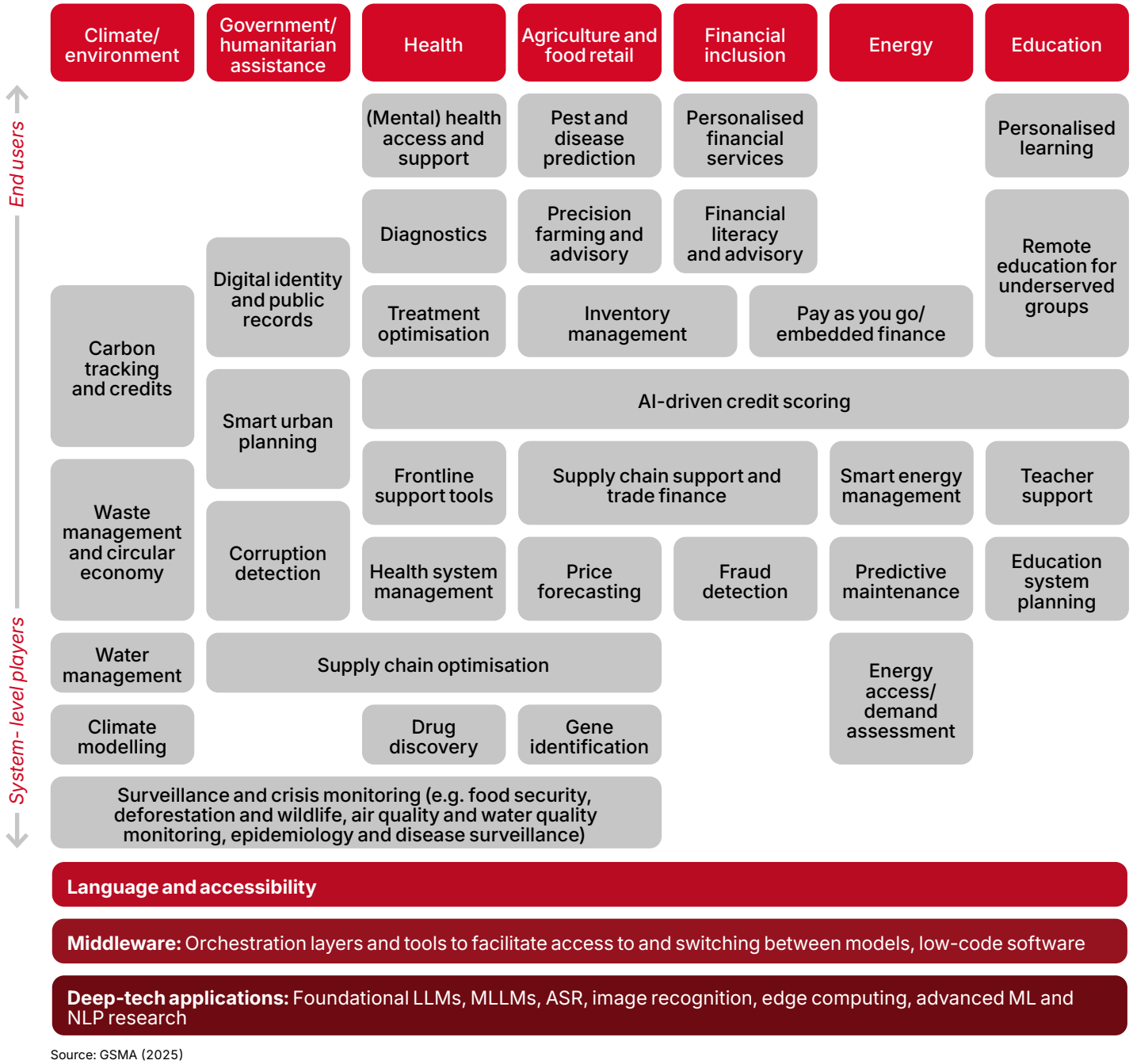


AI for development: overview of use cases

Many AI use cases in LMICs are built on top of existing infrastructure, models and middleware, such as foundation models, accessibility tools and orchestration layers. Much of the innovation is concentrated in applications, with solution providers adapting and extending these components to local contexts. This often includes developing new algorithms or modifying models to address local data characteristics, language diversity or delivery constraints. While upstream model development may expand over time, much of the current ecosystem is shaped by applied technical work that builds on and localises existing capabilities.

Some AI use cases are cross-sectoral and can unlock value in many areas. For example, credit-scoring tools can be applied in multiple sectors, such as financing for farmers or providing education loans, and at different levels, from assessing individual borrowers to using AI-driven credit scoring for project financing in areas like school construction or renewable energy development.

Figure 3: Overview of AI use cases across sectors



Source: GSMA (2025)

Desk research of more than 300 AI use cases in private sector-led initiatives (e.g. startups and social enterprises), NGOs and CSOs revealed that more than 80% of AI applications in LMICs address challenges in agriculture, healthcare, climate and education.

Table 1: Impactful AI use cases by region and sector

Region	Agritech	Healthtech	Climatetech	Edtech	Humanitarian tech	Assistivetech	Fintech	Renewable energy tech	Digital inclusion	Deeptech
Global (Africa, South Asia and Southeast Asia)	31%	24%	13%	9%	4%	4%	4%	4%	3%	3%
Africa	33%	26%	14%	8%	3%	2%	4%	4%	2%	3%
South Asia and Southeast Asia	28%	21%	11%	11%	6%	8%	4%	3%	4%	3%

Source: GSMA (January 2025)

Figure 4 outlines the criteria used to select the AI use cases featured in this report. They are supported by viable business models, strong partnership opportunities, particularly with mobile network operators (MNOs), and the ability to scale across contexts. Together, these use cases enhance understanding of the AI for development ecosystem and the diversity of AI solutions across sectors, regions and applications.

Figure 4: Criteria for use case selection

Must-have criteria (required criteria for all selected use cases)

1. Role of AI and emerging technology: Is AI and emerging technology additive and a core part of the use case?

2. Impact potential: Does the use of AI enable the company to have a positive impact on vulnerable communities in LMICs?

3. Sustainability and scalability: Is the business model sustainable (i.e. potential for revenue generation, cannot be easily replicated by a larger competitor, successful opportunities for partnerships) and scalable to other contexts?

Sub-criteria for use case selection (criteria to guide final selection of use cases)

A. Mobile integration: Does the use case have potential to integrate with mobile technology, MNOs or offer MNO partnerships for scale?

B. Incremental understanding of the ecosystem: Does the use case add incremental value in understanding the ecosystem of AI for development? (i.e. diversity of sector, geography, application)

Source: GSMA (2025)

A framework for case study analysis

For this report, we identified 12 high-potential use cases in sectors where AI is having a demonstrable impact and showing strong potential for scale. Each case study is analysed using a six-point framework that reveals how and where AI is creating value:

1. **AI solution and architecture:** How AI is embedded in the system, including data flows, model design and the technical and operational infrastructure behind the solution.

2. **Value added by AI:** The unique capability, transformation or impact of AI, such as extending access, enabling personalisation, improving decision-making or driving automation.

3. **Tier of impact:** Who benefits from the AI solution and how, from economic gains and better well-being to broader systemic and environmental outcomes.

4. **Point of intervention:** Where AI is being applied in the service delivery or value chain, whether directly with end users, through intermediaries such as frontline workers or at a systemic level.

5. **Potential for scale:** The ways in which the solution can evolve or grow, including geographic expansion, adaptation to new use cases and development of sustainable partnerships and business models.

6. **Role of MNOs:** The role that MNOs can play in improving the reach, affordability and integration of AI-enabled services, particularly in low-connectivity environments.

Together, these dimensions provide a common framework for understanding the role of AI in addressing complex challenges in low-resource and underserved environments. An overview of the selected case studies is presented in Table 2.

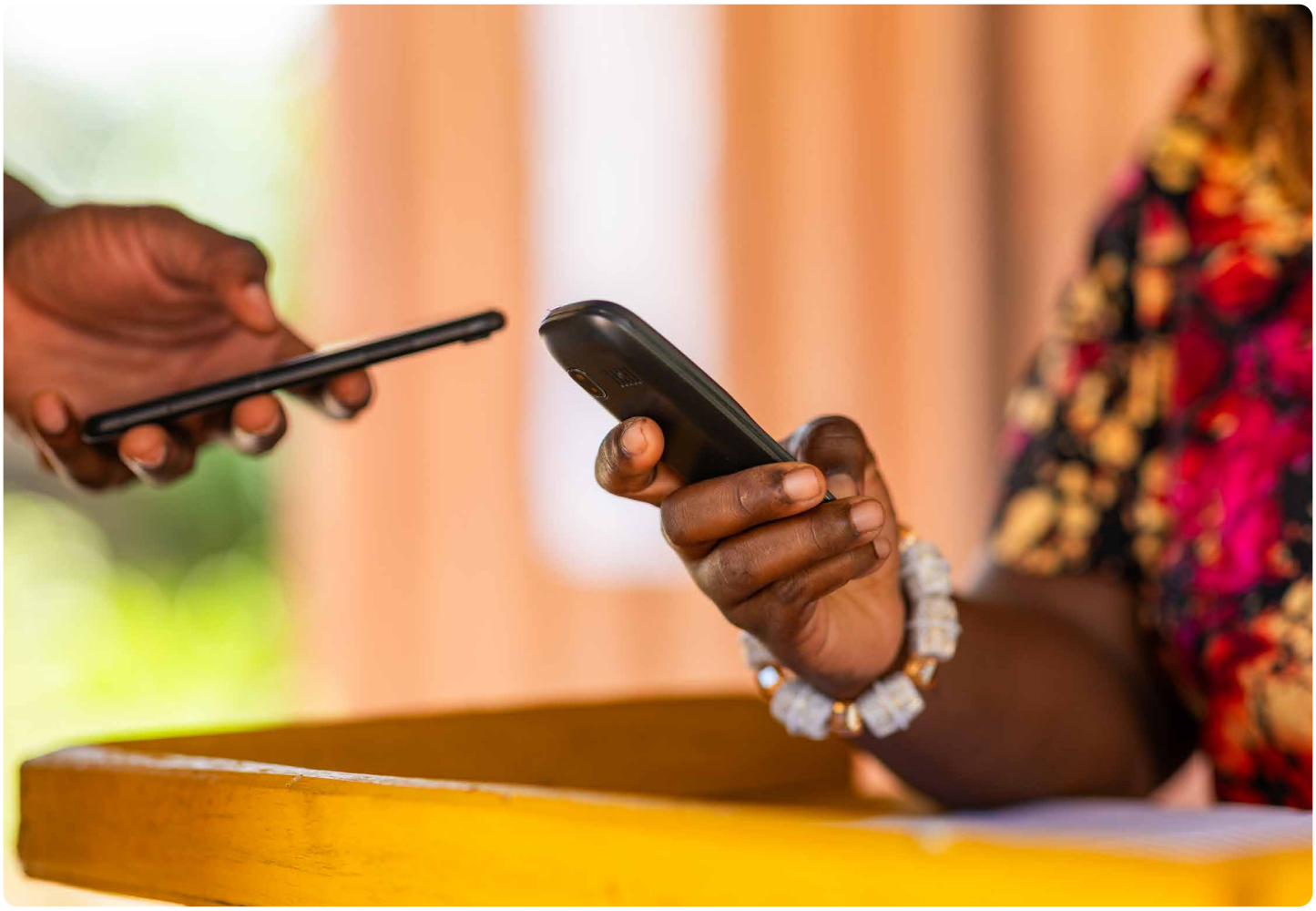


Table 2: Overview of the 12 case studies

Organisation	Country	Region	Type	Sector	Use case
Digital Green	Multiple	Africa and Asia	Non-profit	Agriculture	GenAI chatbot for extension workers and farmers
Varaha	Multiple	South Asia	For profit	Agriculture/ Climate action	Integration of smallholder farmers in carbon markets
Jacaranda Health	Multiple	Africa and Asia	Non-profit	Health	GenAI chatbot for mothers during and after pregnancy
LifeBank	Nigeria	Africa	For profit	Health	AI and blockchain to deliver critical medical supplies efficiently
Khushi Baby	India	Asia	Non-profit	Health	Maternal/child health, focus on underserved communities and supporting extension workers
Simprints	Multiple	Africa	Non-profit	Humanitarian assistance/Health	Biometrics tailored for low-resource contexts
Trestle Labs	India	Asia	For profit	Digital inclusion/ Assistivetech	AI for assistive technology
InvestEd	Philippines	Asia	For profit	Fintech	AI-led credit scoring for educational loans
Orca	South Africa	Africa	For profit	Fraudtech	Fraud prevention in emerging markets
&frnds	Multiple	Africa and Asia	For profit	Retail digitalisation/ Embedded finance	Supply chain digitalisation and AI-enabled trade finance for microretailers and wholesalers
SmartTerra	Multiple	Asia	For profit	Digital utilities/ Climate action	Digital twins for water municipalities to reduce water loss
Husk Power Systems	Multiple	Africa and Asia	For profit	Renewable energy	AI for planning and managing mini-grids

These 12 case studies illustrate how AI solutions are being applied across sectors and regions, highlighting diverse and impactful approaches and their potential for scale.

Case study: **FarmerChat by Digital Green**

Context

Smallholder farmers in low- and middle-income countries (LMICs) continue to face challenges in accessing timely and relevant information for effective crop management, pest control and market access. Traditional agricultural extension services depend on extension agents delivering advice that is both prompt and tailored to farmers' needs. For instance, the Food and Agriculture Organization (FAO)[37] of the United Nations recommends a ratio of one extension agent per 1,000 farmers in Nigeria but the reported ratio is much higher, ranging from 1:5,000 and sometimes even 1:10,000.[38] This disparity, combined with widely varying soil conditions, climate and crop varieties, make it difficult to provide recommendations that are personalised, relevant and accurate.

While digital agriculture has potential to reach more farmers, increase productivity, complement traditional extension services and improve livelihoods, it has faced several challenges. Information and advisory services,[39] extension support training and video-based educational programmes all show promise, but their reliance on curated materials and human facilitation limits both their potential to scale and adapt to diverse contexts.

About Digital Green

Founded in 2008, Digital Green is a non-profit organisation that strives to enhance agricultural productivity and climate resilience by supporting public agricultural extension services. Digital Green's farmer-to-farmer video model is a pioneering, evidence-based and participatory approach first deployed in India and later expanded to Ethiopia, Kenya, Nepal and Nigeria. Digital Green provides context-specific advisory for smallholder farmers and trains extension agents to use technology and digital tools to provide more efficient, relevant and impactful support.

Digital Green's video-based training for female farmers

Source: Digital Green

Organisation profile

Year founded: 2008

Business type: Non-profit, business-to-government (B2G)

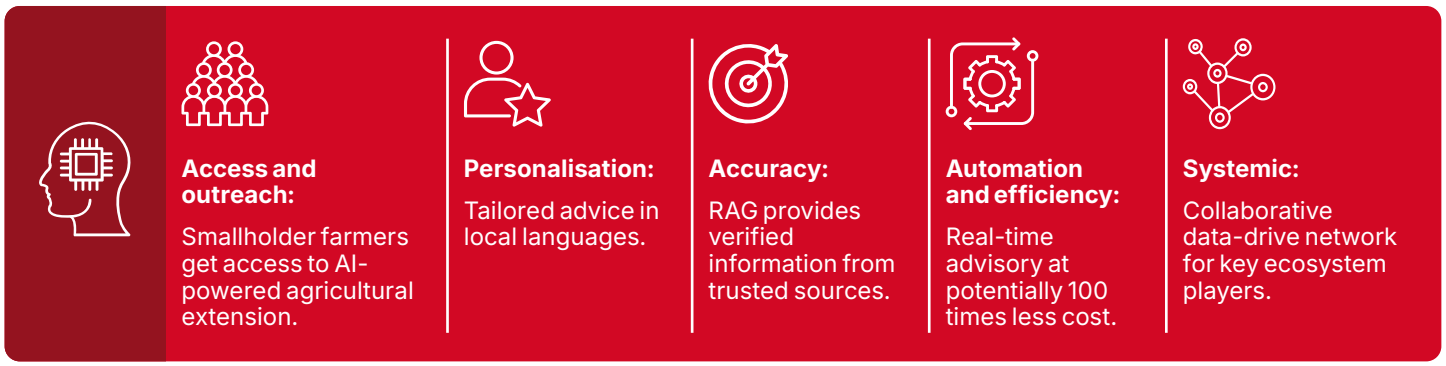
Funding: Grants (e.g. MacKenzie Scott, BMGF, IFAD, Rockefeller, FCDO)

Team size: 100+

Geographies: India, Kenya, Ethiopia, Nigeria, Brazil, Zimbabwe

37. FAO.
38. Rasaq, E. (20 September 2024). "How Dearth of Extension Workers Worsens Agric Sector Woes". *The Guardian Nigeria*.
39. GSMA. (2022). *Data-driven advisory services for climate-smart smallholder agriculture*.

Figure 5: The value AI adds to FarmerChat



Source: GSMA

AI solution and architecture

Digital Green initially provided advisory through video-based programmes for local farmer community groups. Its community-made, hyperlocal videos and human-mediated instructions were intended to provide cheaper and more effective agricultural extension services. Building on this model, Digital Green introduced FarmerChat, a channel-agnostic, AI-driven digital platform that delivers on-demand, real-time, personalised and climate-smart advisory services through multi-sided interactions between farmers, extension workers and implementing partners.

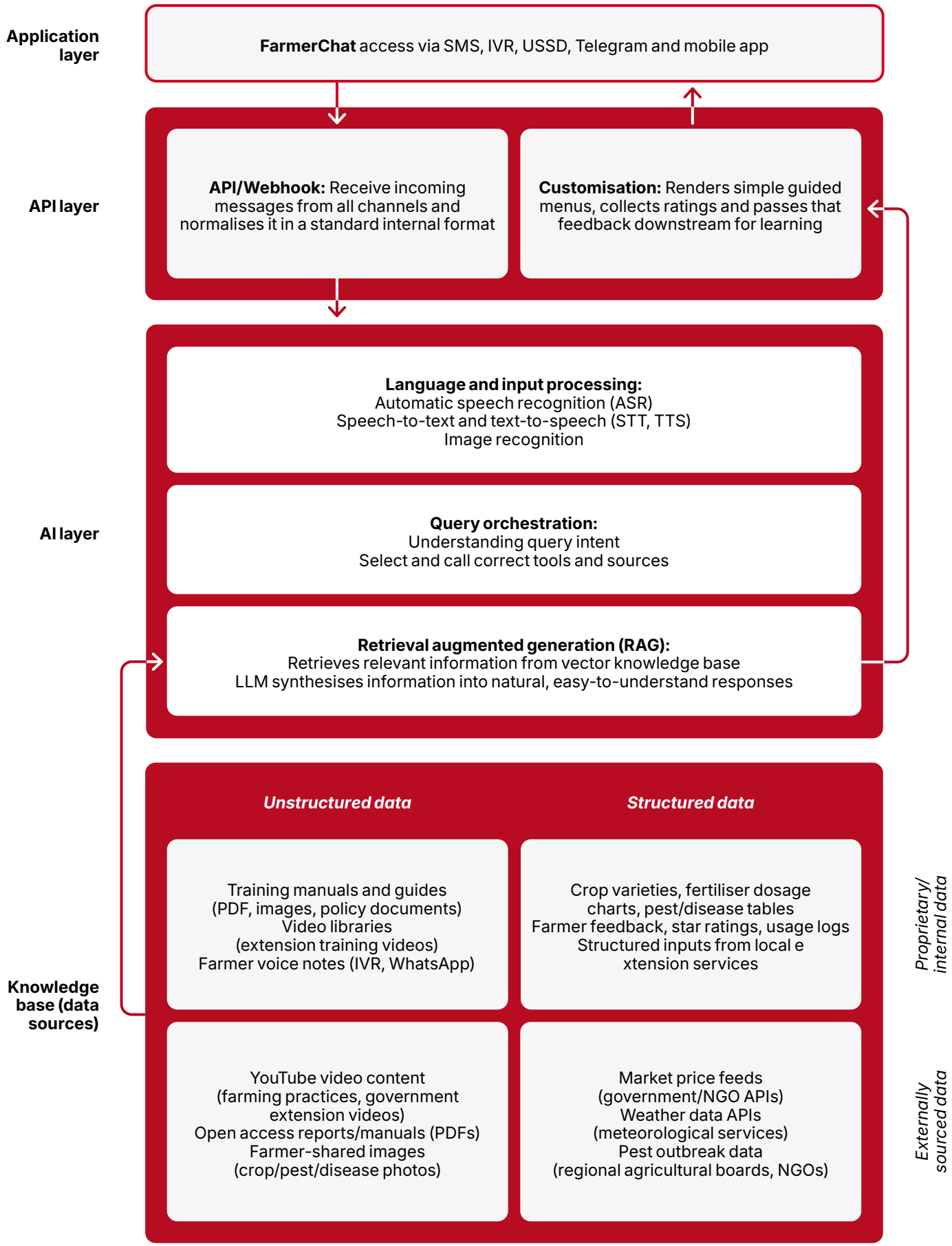
At the core of FarmerChat (see Figure 6) is a sophisticated Retrieval-Augmented Generation (RAG)[40] pipeline to deliver accurate and relevant information to farmers. The RAG pipeline uses an LLM to retrieve information from a vast knowledge base and then generate a personalised, concise and informative response. The system integrates foundation models such as GPT and Llama through partnerships with OpenAI and Meta, and leverages NLP capabilities to interpret farmer queries. An embedded search layer retrieves relevant entries from a domain-specific knowledge base, which includes advisory videos, climate and weather data, agricultural extension content, call centre logs and farmer-reported inputs, before synthesising a response. This response is translated into the user's preferred language and delivered on their chosen channel.

The platform uses a modular tech stack that integrates with local language translation datasets and services in each country, operating in multiple languages like Hindi, Swahili, Amharic and other regional languages. The AI-enabled service offers multimodal interaction, including voice, text and image inputs, and functions across a range of communication channels, such as a mobile app, Telegram, SMS and IVR. However, usability varies significantly between traditional (IVR, SMS and USSD) and digital (mobile app and Telegram) channels, as multimodal interactive user experiences can only be offered through digital channels.

FarmerChat is essentially a digital platform operating as a domain-specific layer built on top of existing foundation models. It is designed to be modular and driven by both APIs[41] and Model Context Protocol (MCP),[42] enabling integration with local and global data sources (e.g. meteorological APIs, soil datasets), partner platforms (e.g. national agriculture portals) and MNOs. It leverages different models for various components of the technology stack depending on performance and cost considerations, and is increasingly fine-tuning lightweight, open-source models to reduce costs and improve accuracy. Continuous learning is built into the system as expert-reviewed conversations and farmer feedback are used to refine the training data and improve model accuracy. A lightweight evaluation technique that uses LLM-as-a-judge[43] provides ongoing performance monitoring to assess the accuracy and usefulness of responses in real time.

40. Definition by IBM: Retrieval augmented generation, or RAG, is an architecture for optimising the performance of an AI model by connecting it with external knowledge bases. RAG helps LLMs deliver more relevant, higher quality responses.
41. Definition by IBM: An API, or application programming interface, is a set of rules or protocols that enables software applications to communicate with each other to exchange data, features and functionality.
42. Definition by IBM: Model Context Protocol (MCP) serves as a standardisation layer for AI applications to communicate effectively with external services such as tools, databases and predefined templates.
43. Singh, V., Manokaran, R. and Roucher, A. (28 October 2024). "Expert Support Case Study: Bolstering a RAG App with LLM-as-a-Judge". *Hugging Face Blog*.

Figure 6: FarmerChat architecture



Source: GSMA

Technology profile	
Type of AI:	Generative AI (GenAI)
Type of technology used:	NLP, LLM, RAG, MCP
MNO partners:	Safaricom (Kenya), Ethio telecom (Ethiopia)
Technology partners:	Microsoft, OpenAI, Google, Hugging Face, Meta, GitLab
Main users:	Agricultural extension workers, smallholder farmers
Delivery channels:	Mobile app, Telegram, IVR, SMS, USSD

Business model

Digital Green operates as a non-profit organisation, funded primarily by philanthropic donors, multilateral agencies and public-sector implementing partners. To become more sustainable over the long term, Digital Green is exploring commercial partnerships that align with its mission.

The development of FarmerChat has been funded and supported by a range of donors, foundations and partners, including The Rockefeller Foundation,[44] The Agency Fund,[45] GitLab Foundation[46] and The UK Foreign, Commonwealth & Development Office.[47] While FarmerChat is available to farmers for free, its adoption and effectiveness is limited by infrastructure challenges, limited digital access and low literacy rates.

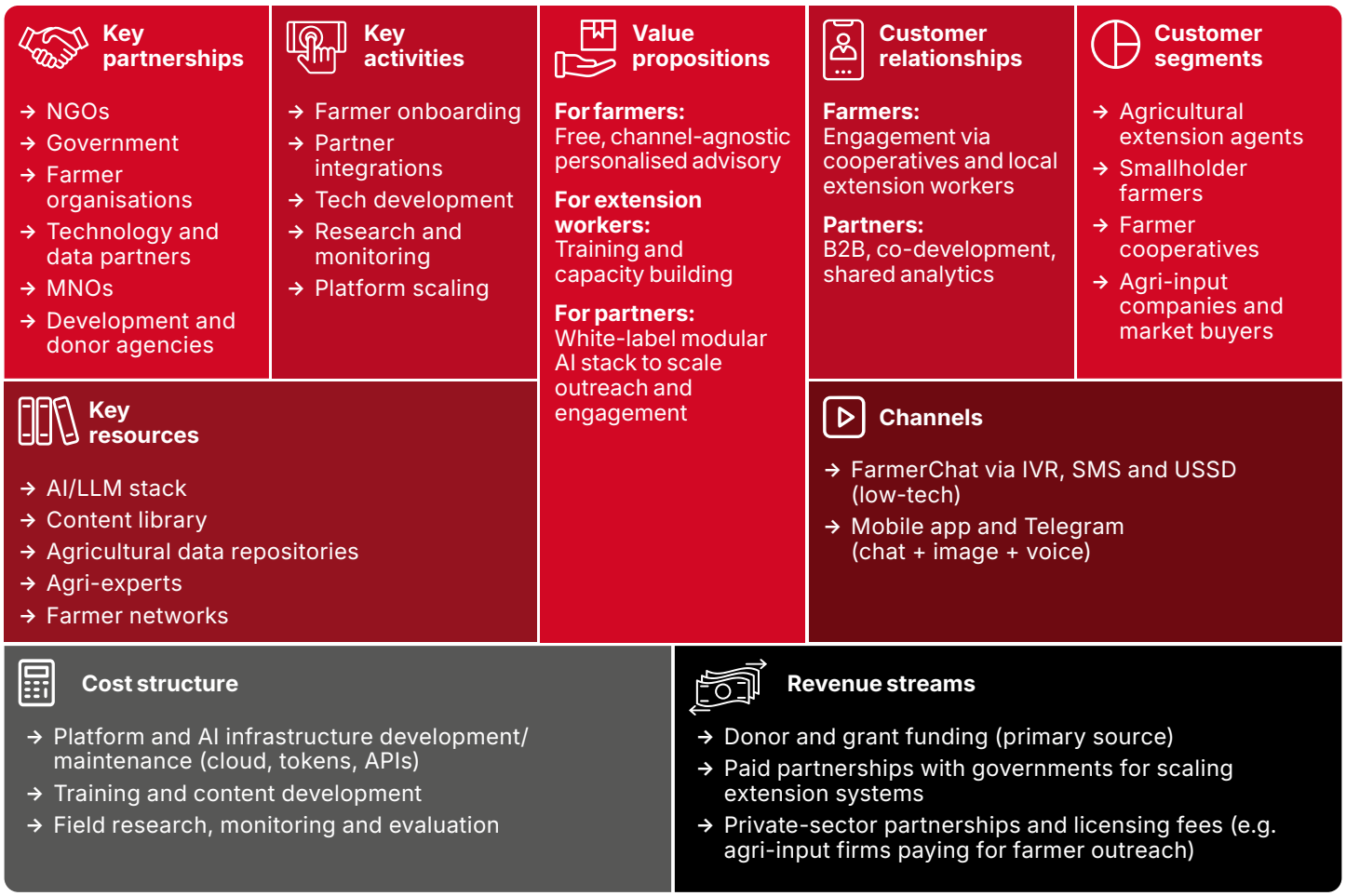
To address these challenges, Digital Green is piloting other viable business models, such as a hosted, white-label software-as-a-service (SaaS) version of the FarmerChat digital platform for agricultural companies, NGOs, development agencies and input suppliers. Through this model, partners would be able to integrate FarmerChat's AI stack in their own advisory services, enabling them to expand outreach and improve engagement. The associated licence fees would contribute to the maintenance of current services and the development of new features. There is also an opportunity to explore micro-subscription models or freemium/premium features tailored for farmer producer organisations (FPOs),[48] cooperatives and agri-entrepreneurs. These could offer advanced analytics or tailored farm planning tools while keeping core advisory services free for low-income users.

Digital Green is also testing shared-value partnerships with MNOs and agritech platforms to enable service delivery through zero-rated internet access and USSD-based channels. This would expand the reach of FarmerChat to low-income users and those with basic phones or limited connectivity while offering MNOs new customer engagement pathways and potentially higher customer retention.

Additionally, the company has open-sourced its own software,[49] datasets and training and validation models[50] as digital public goods to encourage impactful innovation and enable other organisations to build solutions on top of them. This approach promotes collaboration by allowing external developers, researchers and NGOs to contribute improvements, customise features and share best practices. It also opens potential revenue streams without restricting access, through hosted AI services, SaaS solutions or partnerships with upstream agricultural companies and MNOs, while keeping the core platform fully open source.

44. Hamilton, M. (24 April 2024). "An AI-Powered App Fights Climate Change While Revolutionizing Farming". The Rockefeller Foundation.
45. The Agency Fund, "Digital Green".
46. GitLab Foundation. (n.d.). "Empowering Kenyan Farmers: How AI Is Revolutionizing Agriculture with Digital Green".
47. Digital Green, Case Study (Intellecap, December 2023)
48. Agriculture Institute. (14 December 2023). "Understanding the Formation and Concepts of FPOs".
49. Digital Green. "Farmer-Chat README". GitHub.
50. Hugging Face. "Digital Green".

Figure 7: FarmerChat business model canvas



Source: GSMA (2025)

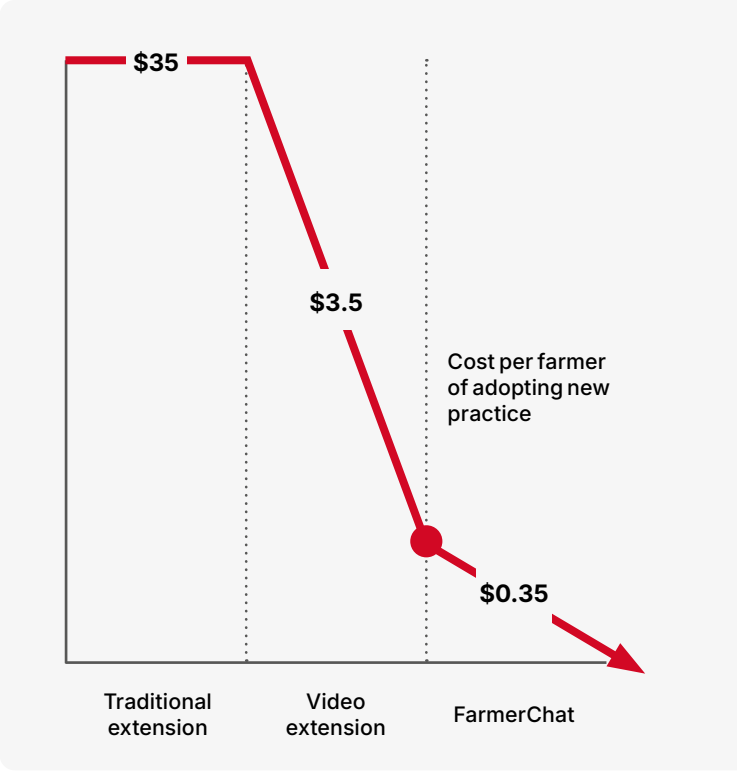
Impact and results

The impact of FarmerChat lies in the reach, relevance and affordability of its agricultural advisory services. Digital Green's AI-enabled solution helps bridge the information gap in the last mile of LMICs, especially for smallholder farmers in remote or low-connectivity areas. The digital platform works across widely used communication channels, is optimised for low-literacy settings and supports interaction in multiple formats and local languages, making it broadly accessible to farmers regardless of their digital fluency.

Using video-enabled agricultural extension, Digital Green automates parts of the advisory process and makes service delivery more scalable. Independent evaluations indicated that this approach was up to 10 times more cost-effective than traditional face-to-face extension methods, with cost per adoption of improved farming practices reduced from approximately $35 to $3.50, while increasing outreach to 30% more farmers.[51,52] FarmerChat has been developed on the foundation of Digital Green's accumulated library of farmer-facing knowledge resources, including scripts, videos and extension guidelines. Preliminary estimates suggest that by applying GenAI, the cost per farmer of adopting improved farming practices could be reduced by as much as 100 times, from around $35 to $0.35 per farmer.[53]

51. Franzel, S., Sinja, J. and Simpson, B. (2019). *Farmer-To-Farmer Extension: A Low-Cost Approach for Promoting Climate-Smart Agriculture*. CCAFS/World Agroforestry Centre.
52. Gandhi, R., Veeraraghavan, R., Toyama, K. and Ramprasad, V. (2008). "Digital Green: Participatory video for agricultural extension". 2007 International Conference on Information and Communication Technologies and Development. IEEE.
53. Digital Green.

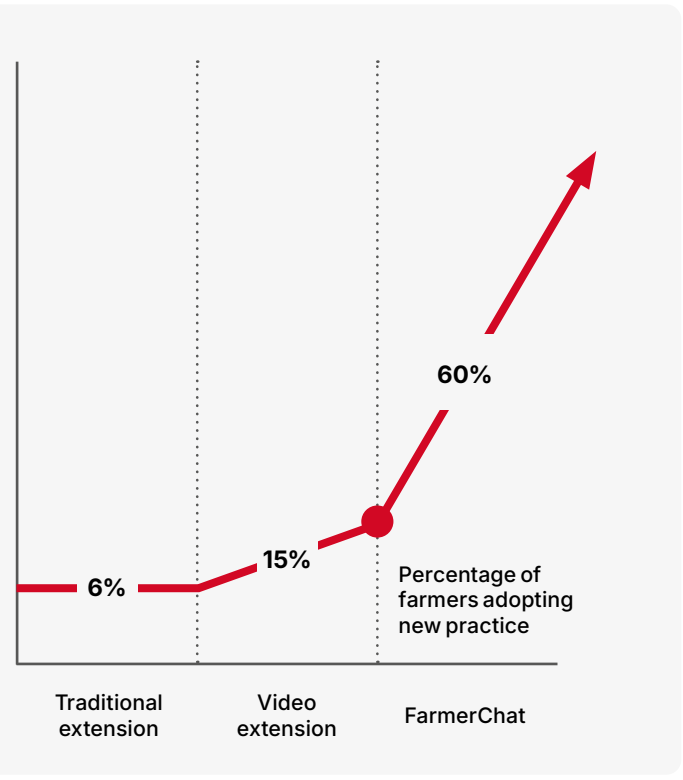
Cost per farmer of adopting new farming practices



Source: Digital Green

FarmerChat supports both direct users (farmers) and intermediaries (extension agents), creating a hybrid model that boosts the efficiency of public agricultural extension systems while empowering farmers to make timely, informed decisions. Digital Green has reached more than 8.2 million farmers, 43% of whom are women, through their tech-assisted solutions.[54] As of 2025, 320,000 individual users have accessed FarmerChat, 60% of whom report adopting a new practice because of FarmerChat recommendations, and 95% report time savings and overall satisfaction.

Percentage of FarmerChat users adopting a new farming practice

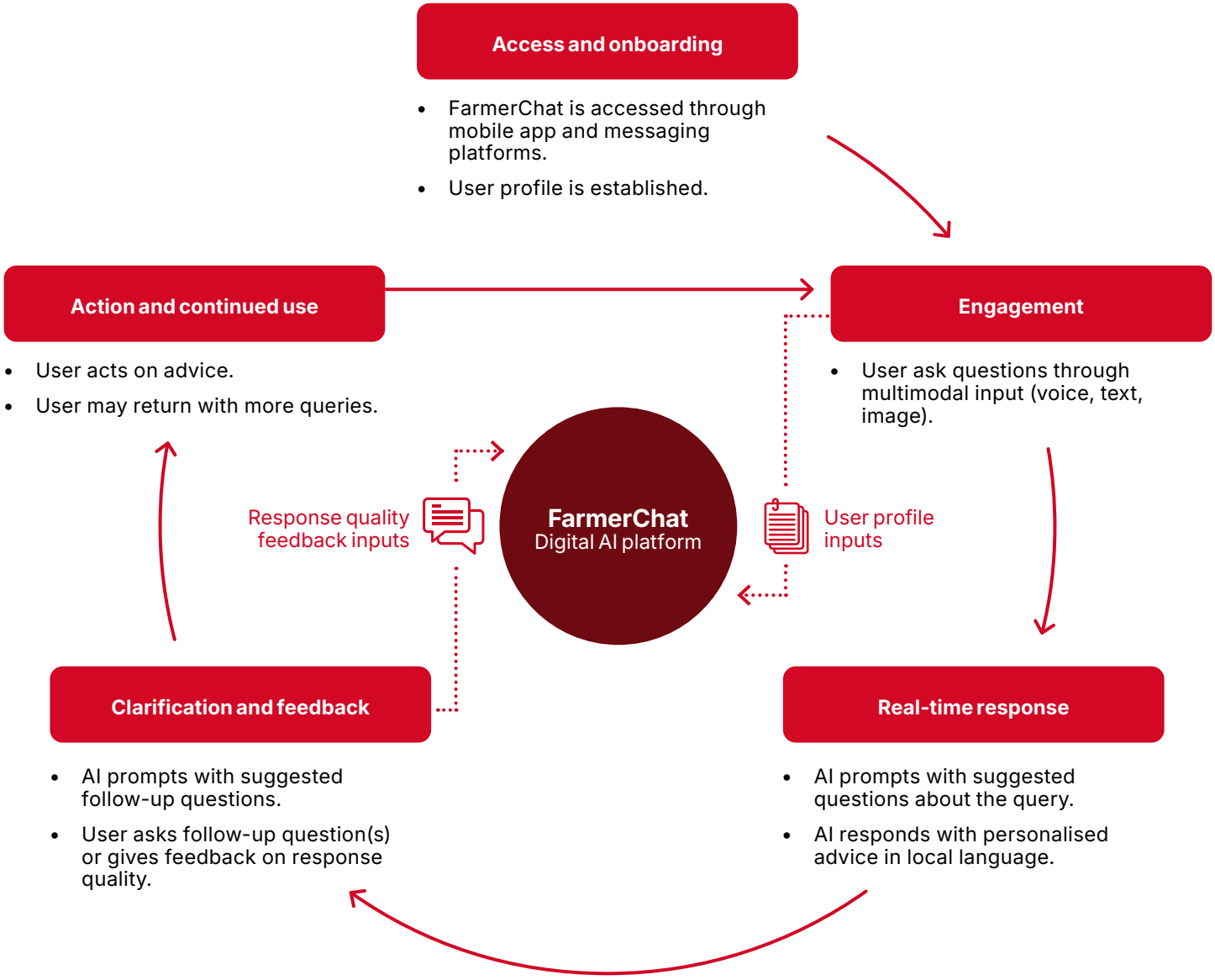


Source: Digital Green

54. Digital Green.

In addition to lower service costs, higher farmer incomes and greater convenience, the platform also promotes the adoption of climate-smart agricultural practices. By delivering locally tailored, real-time guidance, FarmerChat strengthens farmers' ability to respond to climate shocks, adopt sustainable farming practices and enhance their long-term resilience, generating both economic and environmental impact at scale.

Figure 8: FarmerChat user journey



Source: GSMA (2025)

At the onboarding stage, FarmerChat asks the user questions to establish a farmer profile (gender, farm location, crops grown, etc.). The profiles are further strengthened based on the interactions with the service. FarmerChat also prompts users with suggested questions based on their queries and those of their peers. To improve the quality of advisory, the team is working on developing a more advanced, context-aware, multiturn conversational flow.

Challenges and future outlook

Localisation versus scale

Digital Green's successful partnerships with governments, NGOs and farmer community groups positioned it to develop and deploy FarmerChat, but scaling the service brings a new set of challenges. Due to the fragmented nature of agricultural value chains, diverse farming practices and regional differences in weather conditions, soil types and disease outbreaks, multiple datasets need to be developed and managed to offer real, valuable and personalised advisory services. This makes content development resource-intensive and costly.

Continuous product innovation

Digital Green aims to enhance both the functionality and accessibility of FarmerChat through continuous product innovation. One area of focus is the development of task-based automation features enabled by the integration of OpenAI's operator,[55] which will allow the platform to perform actions on behalf of its users. For Digital Green staff, this includes automating repetitive workflows such as fetching market prices, updating crop advisories and curating video content for training FarmerChat. For extension agents, automating localised pest management advisories for their assigned villages based on the latest weather and pest outbreak data will save hours of manual research and messaging.

By handling these routine tasks, users will be able to focus on higher-value strategic activities and increase the efficiency of their work. Realising this vision will depend on several factors: expanding mobile access for farmers and extension agents, strengthening strategic partnerships across public and private sectors and maintaining user trust through transparent, relevant and consistently high-quality AI-generated content.

Two years after its initial deployment, Digital Green continues to face challenges in scaling FarmerChat, particularly in ensuring that AI systems are responsive and reliable in low-resource languages. While global models perform well in English and a handful of widely spoken languages, they often fail to capture the nuance of local dialects, agricultural terminology and region-specific phrasing. This can lead to generic or inaccurate responses that undermine trust and limit adoption. Addressing this requires sustained investment in curating localised datasets, building translation layers and fine-tuning smaller language models that can run efficiently in resource-constrained environments.

For many smallholder farmers, especially those in remote rural areas with limited connectivity or basic phones, the ability to interact in their own language through IVR, SMS or USSD is the difference between meaningful advice and unusable information. Alongside technical improvements, continuous support is needed to help users with low digital literacy engage confidently with the service.

LLM costs

Traditional large language models (LLMs), such as GPT implemented by Digital Green for FarmerChat, demand significant computational resources for both training and inference. These LLMs are often accompanied by licensing fees that typically involve a subscription or pay-per-token charges, making it challenging to scale a solution to millions of rural farmers who access the service for free.

To improve efficiency, cost-effectiveness and control, the Digital Green team is also exploring small language models (SLMs) and fine-tuned open-source alternatives to proprietary AI models. This transition supports more localised deployment, reduces operating costs and strengthens data sovereignty, especially in LMIC contexts with limited compute capacity.

Together, these efforts are essential to ensure that FarmerChat remains inclusive and impactful, reaching farmers in the languages they trust on the devices they already use, and adapting dynamically to their needs.

55. OpenAI. (23 January 2025). "Introducing Operator". *OpenAI Blog*.

Case study: **Varaha**

Context

Smallholder farmers in LMICs produce a substantial share of the world's food and play a critical role in sustaining local and global food systems, but remain largely excluded from global carbon markets. Carbon markets are carbon pricing mechanisms that enable governments and non-state actors to trade greenhouse gas emission credits to achieve climate targets and implement climate actions cost-effectively.[56] Carbon markets facilitate the trade of carbon credits, also known as carbon allowances, which work like permission slips for emissions. When a company buys a carbon credit, they gain permission to generate one tonne of carbon dioxide (CO2) emissions.[57]

The exclusion of smallholder farmers from carbon market systems stems from several structural and operational barriers, including a lack of formal documentation, limited awareness of carbon credit mechanisms and low levels of digital and technical literacy. Traditional carbon credit systems rely heavily on manual verification, self-reported data and intermediaries, creating inefficiencies and limiting transparency between farmers, project developers and certification bodies. The result is a system that is both inaccessible to smallholder farmers and fails to catalyse large-scale, transformational impact.

About Varaha

Varaha is an India-based climate tech company that leverages AI, remote sensing and data analytics to enable smallholder farmers to participate in high-integrity carbon markets.

Founded in 2022, the company uses AI and emerging technologies to streamline onboarding, automate verification and improve traceability. Varaha's goal is to make climate finance equitable and accessible by ensuring that farmers adopting sustainable practices, such as regenerative agriculture,[58] agroforestry[59] and biochar[60] production, receive verified carbon credits for their efforts.

Varaha works with local field partners, NGOs and FPOs to collect ground-level data and support both farmer- and buyer-facing digital tools. The company's AI-first approach automates large parts of the carbon verification process, helping to overcome traditional barriers of language, documentation and traceability that prevent smallholders from participating in carbon markets.

Organisation profile

Year founded: 2022

Business type: For profit

Stage: Early growth

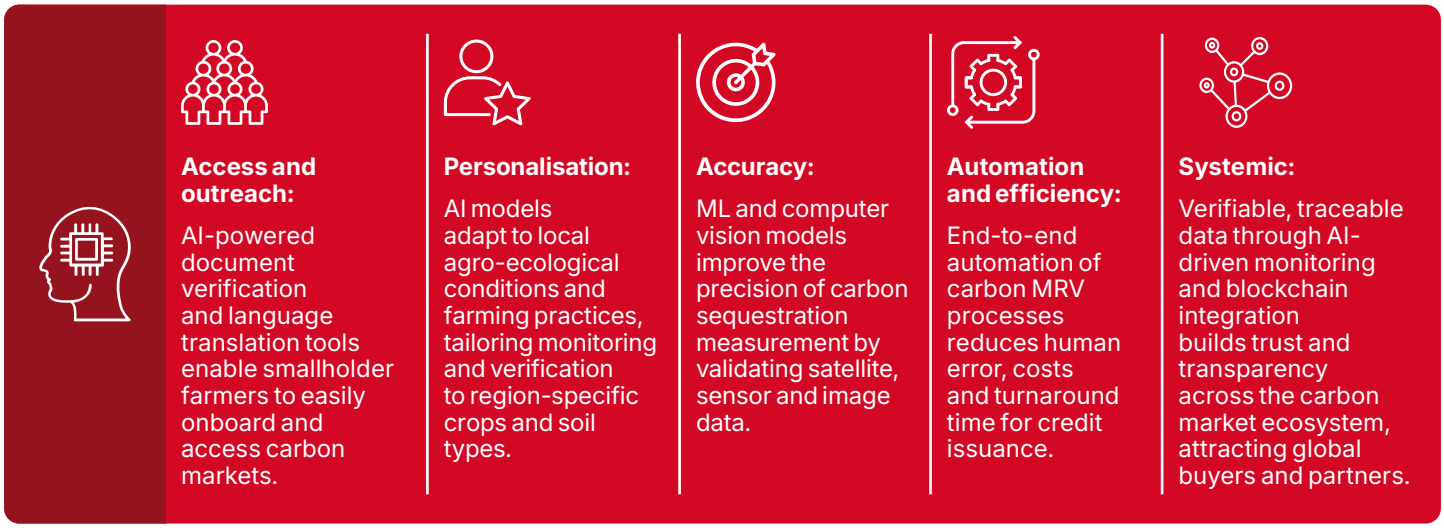
Funding: Series A

Team size: About 130

Geographies: India, Nepal, Bangladesh, Southern Africa

56. UNEP. (n.d.). "Carbon Markets".
57. Carboncredits.com. (n.d.). "The Ultimate Guide to Understanding Carbon Credits".
58. World Economic Forum. (11 October 2022). "What is regenerative agriculture?"
59. FAO. (n.d.). "Agroforestry".
60. Biochar is a form of charcoal created by heating organic material, known as biomass, in an environment without oxygen at temperatures of 400°C or higher.

Figure 9: The value AI adds to Varaha



Source: GSMA

AI solution and architecture

Varaha's AI-powered measurement, reporting and verification (MRV)[61] system underpins its end-to-end approach to carbon credit generation and carbon dioxide removal. It integrates field-level data, remote sensing and machine learning (ML) to measure, monitor and verify carbon sequestration[62] from regenerative agriculture, agroforestry and biochar projects.

Varaha's AI system automates processes, including farmer onboarding and MRV throughout the project life cycle. The company continuously collects region- and crop-specific data to retrain its AI models to ensure accuracy, fairness and adaptability across diverse agro-ecological zones. This approach enables the system to scale and lends scientific credibility to carbon projects while facilitating direct value for smallholders.

The foundation of Varaha's technology is the diversity of its data ecosystem, which captures both on-ground and remote indicators of carbon removal. The company's AI models draw from multiple data sources, including satellite imagery, sensor and IoT data, farmer and field-level information and photographic evidence.

High-resolution satellite imagery sourced from open-access repositories is used to detect changes in land use, monitor tree water use and assess soil and vegetation cover over time. Field-based IoT devices and sensors collect data on soil health, temperature and gas flows from biochar kilns, offering real-time insights into the volume and quality of carbon captured. Farmers and field officers use the mobile app to upload geotagged photos of farming equipment and activities like

IoT-based Lysimeter[63] in field for enhanced rock weathering (ERW)[64] measurements

Source: Varaha

61. Measurement, reporting and verification (MRV) is a set of procedures and technologies used to accurately quantify, track and validate the climate impact of projects.
62. Carbon sequestration is the process of capturing carbon dioxide from the atmosphere and storing it in a stable form, either naturally or technologically, to mitigate climate change.
63. Lysimeters are instruments used in ERW studies to collect soil pore water to analyse the products of the weathering process, which is key for measuring and verifying carbon dioxide removal.
64. ERW is a process that fast-tracks the natural process of carbon removal. UK Parliament POST. (15 August 2024). "Enhanced rock weathering: Potential UK greenhouse gas removal". *POST-note 726*.

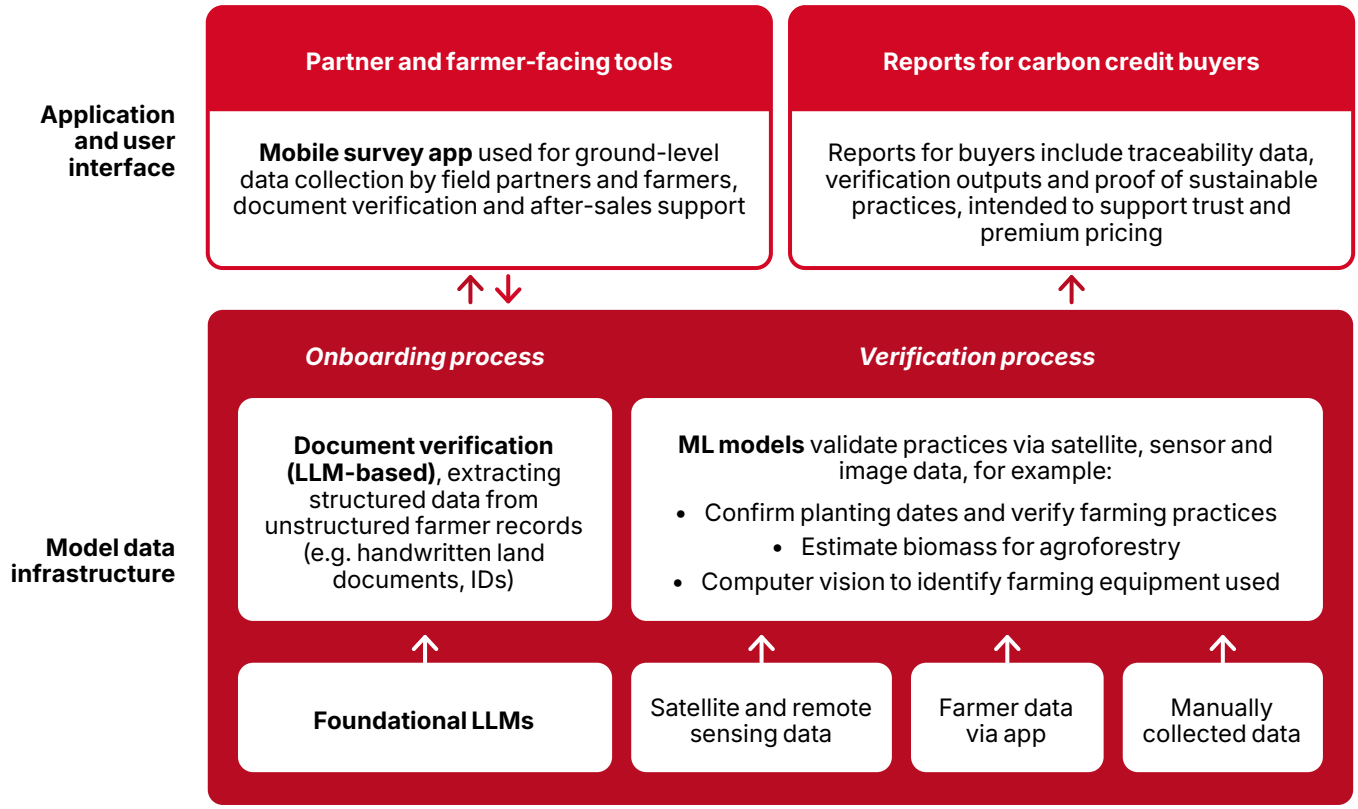
biomass excavation, biochar production and application, providing on-the-ground validation for AI assessments. This multimodal data architecture enables Varaha to triangulate between satellite, sensor and human-generated inputs, and improve the accuracy, traceability and credibility of every verified carbon credit.

During farmer onboarding, the system uses foundational LLMs tailored to local documentation formats to extract structured information from paper-based, handwritten land and identity records, reducing manual processing time and enabling remote registration. Varaha's AI architecture also integrates translation models to overcome linguistic barriers. AI-driven translation tools automatically convert carbon credit contracts, training materials and farmer communications into local languages, making complex carbon market mechanisms understandable and transparent. This localisation capability strengthens farmer participation and builds trust across the value chain.

Varaha's blockchain-based, registry-backed tech platform securely records verified carbon credits on an immutable ledger, providing end-to-end traceability from project origination to issuance. By leveraging blockchain, Varaha enhances transparency, prevents double counting and ensures the integrity of credits traded in voluntary carbon markets, a critical factor for global buyers and investors demanding integrity and traceability in the carbon market.

Its AI-driven MRV system verifies and facilitates carbon sequestration by supporting digital and physical infrastructure for carbon removal via regenerative agriculture and biochar, lowering verification costs, improving traceability and building trust between smallholder farmers and global carbon buyers. In doing so, Varaha demonstrates how AI can unlock large-scale, equitable participation in carbon markets while offering traceable, verifiable credits to buyers and passing on financial value to smallholder farmers.

Figure 10: Varaha AI architecture and data flow



Source: GSMA (2025)

Business model

Varaha operates as both a carbon project developer and technology provider. Its core business model is generating and monetising high-quality, verifiable carbon credits derived from smallholder farmer-led climate-smart practices.

Varaha operates a revenue-sharing model by selling verified carbon credits to corporate buyers and carbon marketplaces. A majority share of proceeds is distributed to participating farmers, creating a direct incentive to adopt sustainable agricultural practices, while Varaha retains a margin to sustain operations.

Most of the carbon revenue goes back to farmers.[65] Varaha's services are funded through carbon credit sales rather than upfront farmer fees. As the company scales, it is investing in automation to further reduce costs and increase margins.

Technology profile

Type of AI:	Predictive AI, GenAI
Type of technology used:	ML, predictive analytics, LLMs, computer vision, blockchain, IoT
Main users:	Smallholder farmers, farmer organisations, carbon credit buyers
Delivery channels:	Mobile app, web platform

Figure 11: Varaha business model canvas

Key partnerships

- Local field partners, NGOs and FPOs (for mobilising farmers, ground validation)
- Certification/ registry bodies (e.g. Verra, Puro. earth) for audit and credit issuance
- Remote sensing/ satellite data providers
- Technology and science partners (AI/ML labs, soil science institutes)
- Carbon credit marketplaces or platforms (e.g. Patch, Klimate)
- Investors and climate-finance intermediaries

Key activities

- Development and maintenance of AI/ML analytics platform
- Sensor deployment, data acquisition and integration
- Upstream field services (network mapping, GIS, inspection, installation)
- Downstream field services (temporary sensors, engineer support)

Value propositions

- Significant reduction in non-revenue water (NRW) losses
- Operational efficiency for utilities with limited infrastructure
- AI models built for intermittent supply and sparse data
- Cost-effective "lift-and-shift" deployment approach
- Improved revenue, network reliability and service equity

Customer relationships

- Long-term software subscriptions
- Hands-on training and field support
- Collaborative product customisation
- Maintenance and post-deployment support

Customer segments

- Public water utilities in LMICs
- Municipal and regional governments
- Utilities transitioning to continuous supply
- Corporate partners funding water sustainability projects

Key resources

- AI/ML models and analytics software
- Sensors and field engineering toolkits
- Data infrastructure and cloud servers
- Utility network data (maps, SCADA, billing)
- Technical and operational expertise

Channels

- Direct sales and partnerships with utilities and governments
- Donor-funded or CSR-supported pilot projects
- Industry conferences, workshops and proof-of-concepts
- API integration with existing utility systems (SCADA, GIS, billing)

Cost structure

- AI and software R&D costs
- Sensor procurement and field operations
- Cloud infrastructure and data storage
- Customer onboarding and training
- Support, maintenance and monitoring expenses

Revenue streams

- Subscription and SaaS fees
- Project-based or pilot implementation fees
- Grants and donor/CSR funding
- Performance-based payments linked to NRW reduction

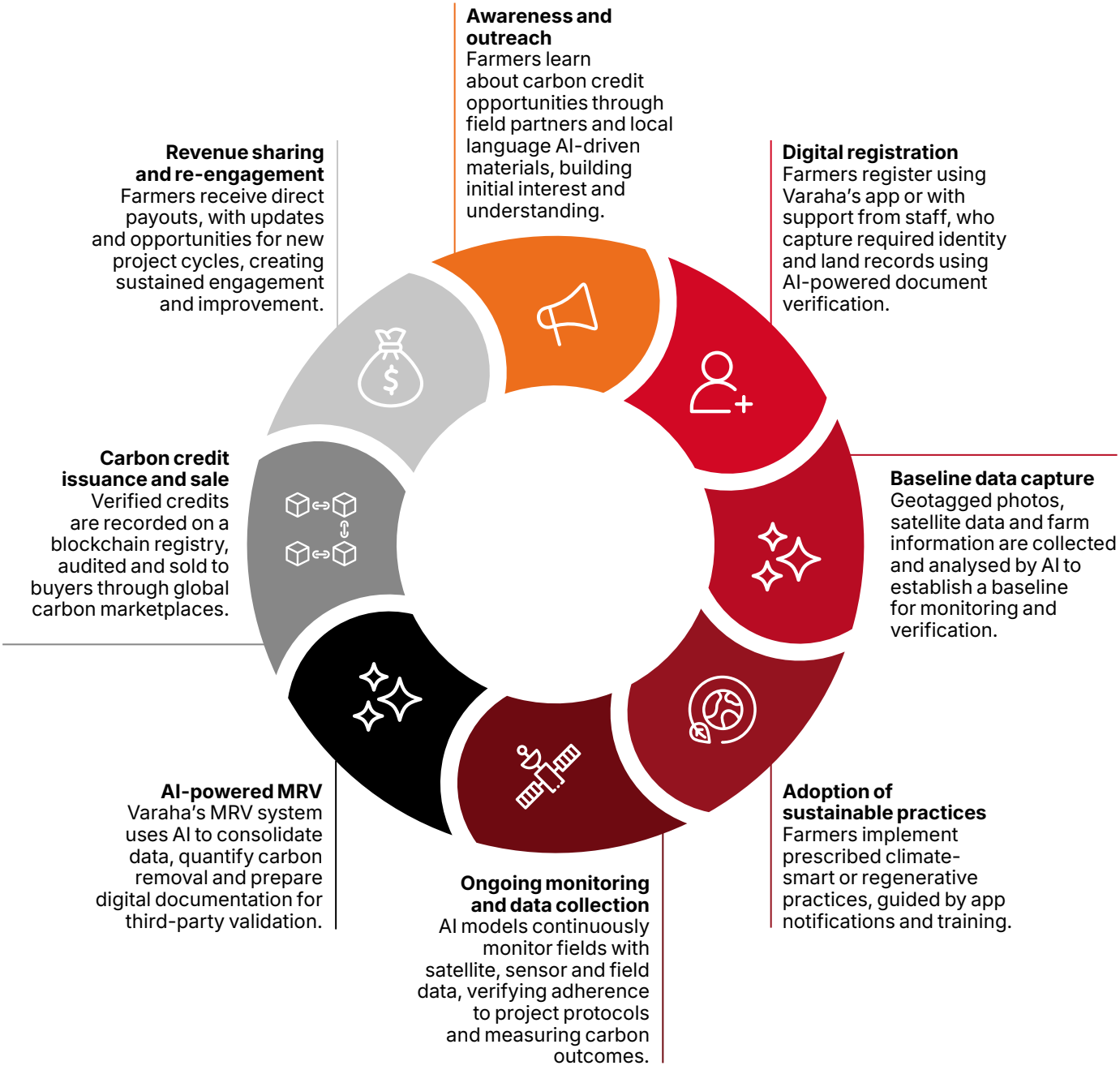
Source: GSMA (2025)

65. Farmers receive 60% to 65% of the value of carbon credits, on average. Varaha usually takes 20% to 25% while 10% to 15% goes to its partners. AgritechDigest.

Impact and results

Varaha's AI-enabled MRV system is facilitating access to climate finance for smallholder farmers while having a measurable environmental impact. By combining remote sensing, AI-based verification, local-language engagement tools and blockchain technology, Varaha has significantly reduced the cost and complexity of carbon credit generation, making participation feasible and attractive for communities historically excluded from climate finance.

Figure 12: Varaha user journey

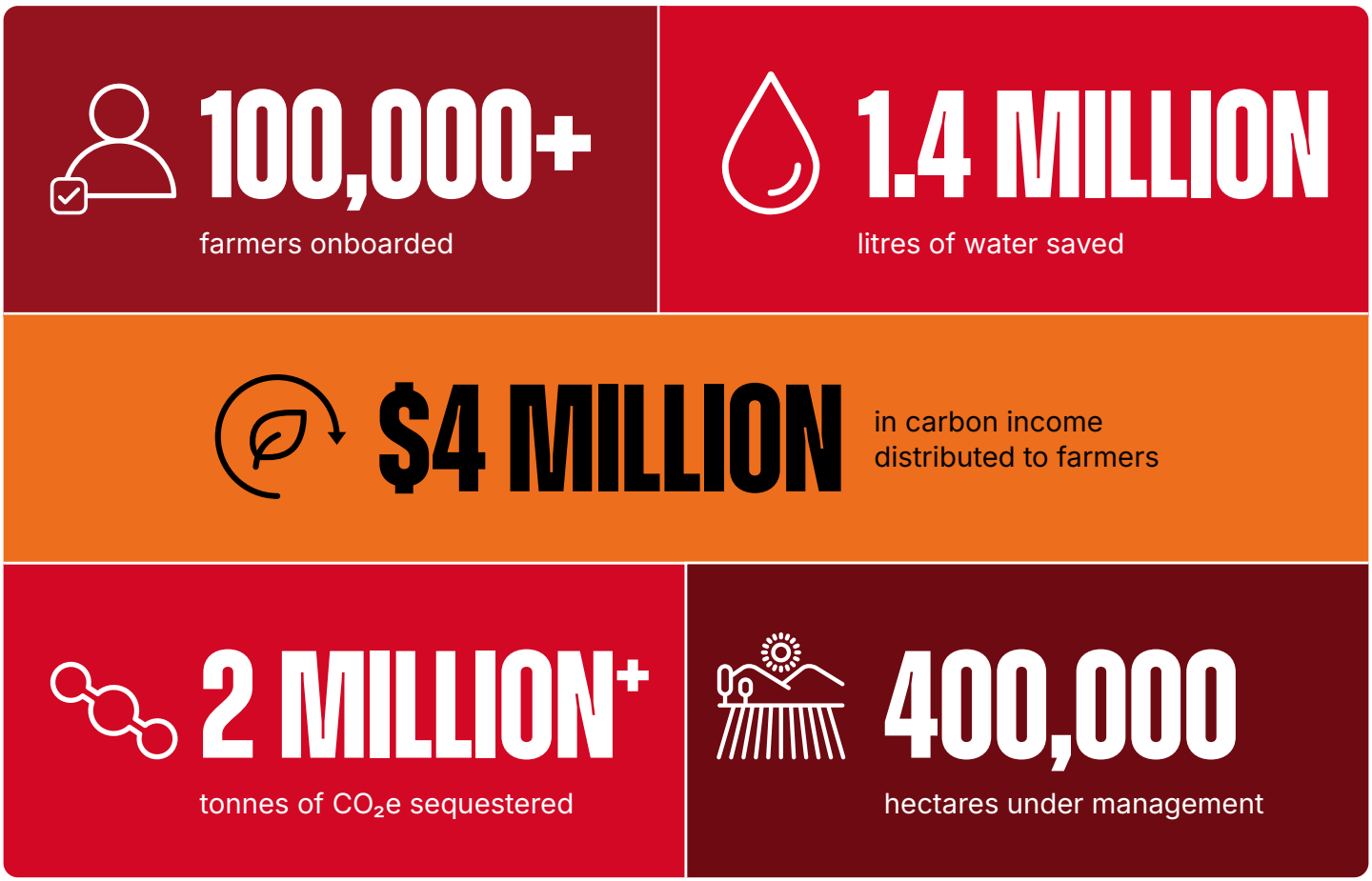


Source: GSMA (2025)

Automation streamlines onboarding and scaling by easing the workload of field staff, enabling verification across thousands of dispersed plots. Document analysis models improve farmer registration while remote sensing reduces verification expenses, allowing a greater share of carbon credit revenues to be passed on to farmers. Together, these technological innovations enhance trust, traceability and the potential for price premiums in the carbon market.

To date, Varaha has onboarded more than 100,000 farmers managing more than 400,000 hectares of land. The company reports saving more than 1.4 million litres of water and facilitating the sequestration of more than 2 million tonnes of carbon dioxide.[66] Varaha has also distributed more than $4 million in carbon income to project farmers, including $1 million to female farmers.

Figure 13: A snapshot of Varaha's impact



Recent market traction

Among its recent milestones, Varaha completed a landmark sale of 100,000 biochar carbon credits to Google,[67] contributing to Google's global commitment to achieve net-zero emissions across its operations and value chain by 2030. This partnership underscores growing confidence in Varaha's high-integrity carbon removal solutions and its role in scaling verifiable climate impact. In parallel, Varaha sold 60,000 credits to Klimate,[68] a Denmark-based carbon-removal platform that aggregates trusted projects for corporate buyers, extending its reach into international voluntary carbon markets.

66. Varaha
67. Google. (16 January 2025). "We're announcing our first partnerships to scale biochar for CO2 removal".
68. Klimate.

Another notable development is Varaha's multimillion-dollar climate finance agreement with Patch,[69] a U.S.-based organisation dedicated to helping businesses invest in credible carbon credit projects. This partnership will support the scaling of carbon removal solutions across Asia, reflecting the strategic role Varaha is playing in advancing sustainable agriculture and climate action on a global scale.

Collectively, these partnerships highlight Varaha's credibility and the growing global appetite for high-integrity carbon credits generated through its technology-enabled platform.

Beyond financial gains, participating farmers benefit from improved climate resilience through better soil health and diversified cropping systems, strengthening their ability to withstand climate shocks.

Challenges and future outlook

While Varaha's AI-driven approach is redefining the economics and accessibility of carbon markets, several challenges remain. The lack of real-time, mobile-based soil testing solutions limits the speed and scale of carbon validation, while alternatives for farmers and field agents are costly and lab tests are slow and logistically complex, particularly in rural and resource-constrained areas. Affordable, portable testing tools could enable instant soil carbon measurements, improving both data accuracy and farmer participation. Limited access to localised and high-resolution weather data also hampers the performance of AI models in diverse agro-climatic environments, making precise carbon sequestration estimates difficult. The high costs of cloud infrastructure and commercial satellite data are another constraint, although Varaha mitigates this by increasingly relying on open-source datasets.

Regulatory complexity also poses challenges for scale, as certification requirements and carbon methodologies vary by country. Adapting AI systems to meet evolving standards without fragmenting the technology stack requires ongoing coordination with verification and certification agencies.

For farmers, awareness and trust remain crucial barriers. Many smallholders are still unfamiliar with the concept of carbon credits or sceptical about the long-term benefits. Building their confidence requires sustained local partnerships, transparent communication and education on how AI supports verification and income generation.

Varaha plans to expand into Southeast Asia and Eastern Africa while deepening investment in AI for soil health and biochar verification. The company is also exploring IoT-enabled biochar monitoring systems to automate volumetric estimation and gas flow tracking. A strong focus on AI talent acquisition and ecosystem partnerships will be critical in its next stage of growth.

As the cost of AI infrastructure declines and open access climate datasets expand, Varaha is positioning itself to scale globally by expanding access to carbon markets, ensuring that smallholder farmers – often the most affected by climate change – can actively contribute to its solutions.

69. Patch.

SPOTLIGHT 1: THE WORLD BANK EXPANDS ACCESS TO AGRICULTURAL DATA

The World Bank's 2025 soil health accelerator in Kenya supports innovators, researchers and policymakers building scalable soil health solutions using AI and ML.[70] For innovators, a major barrier is access to quality datasets, which are essential for any AI solution. Often, innovation challenges provide only temporary access to data. For instance, during the World Bank's 2020 digital agriculture hackathon in Indonesia,[71] partners like Microsoft and local institutions provided access to much-needed ground truth data and satellite imagery, but once the event ended, teams could not afford ongoing access to these datasets.

This experience highlighted the need for sustained collaboration between data holders and innovators. For the soil health challenge, The World Bank partnered with organisations such as KALRO[72] to establish data-sharing agreements and ensure innovators retain access to datasets. To prepare the data, the team anonymised datasets and limited them to select geographies. In total, they brought together more than 19 soil health and related datasets to support impactful AI innovation. For data holders, the challenge opened opportunities to identify new use cases for their datasets, as well as potential business models if solutions were to scale successfully.

The World Bank is also making data more usable internally with GenAI. The Agrifood Data Lab developed a GenAI chatbot for Task Team Leads (TTLs), helping staff working on agriculture and food systems better define AI use cases, design projects and locate and use relevant data.[73] The underlying knowledge base includes the World Bank's extensive data and report repository, along with resources from partners like CGIAR,[74] KALRO and FAO,[75] linked through APIs that ensure staff have access to relevant and up-to-date data.

DATA CHALLENGE FOCUS AREAS

- Precision Agriculture and Location-Specific Soil Management
- Soil Carbon Measurement, Reporting, and Verification (MRV)
- Optimised Fertilizer Distribution and Supply Chain Management
- Generative AI Applications for Soil Health
- Policy Impact Assessment and Decision Support Tools

Source: World Bank

70. World Bank. (2025). "Data for soil health and innovation challenges 2025".
71. World Bank. (2021). "Cultivhacktion – Indonesia Digital Agriculture Hackathon".
72. KALRO.
73. Agrifood Data Lab
74. CGIAR
75. FAO

SPOTLIGHT 2: LERSHA PROVIDES PERSONALISED SUPPORT FOR FARMERS AT SCALE

Lersha is an online marketplace that provides smallholder farmers in Ethiopia and Kenya with services they need to boost their productivity and resilience. From financial services like microloans and crop insurance to farm inputs, mechanisation services and market linkages, Lersha connects more than 270,000 smallholder farmers with more than 250 service providers, such as cooperatives, banks, insurers and offtakers.[76] Lersha also provides real-time, localised agricultural advisory, including weather alerts, pest and disease advice, pricing information and planting and fertiliser guidance. Bundling agro-climate advisory with financial services helps farmers invest in recommended inputs that can boost their yield and productivity, while mitigating risks for both farmers and credit providers.[77]

A hybrid physical and digital model with an in-house call centre, mobile app and network of more than 2,000 agents has given Lersha a wide reach. By integrating ML, Lersha tailors and personalises its agricultural advice and services, boosting farmers' trust. It also offers multilingual translation and voice features to improve accessibility.[78] Lersha is also exploring the integration of AI in services like credit assessment and to support scaling up efforts.

76. Lersha

77. The Alliance of Biodiversity International and CIAT. (9 November 2023). "Empowering Smallholder Farmers: The Benefits of Bundling Agricultural Recommendations with Insurance, Credit, and Climate Advisory Services".

78. GSMA. (2025). *AI in Ethiopia: Promising use cases for development*.

Case study: **PROMPTS by Jacaranda Health**

Context

Maternal and newborn survival rates vary significantly across regions and countries. Despite gradual progress, maternal and newborn mortality in Sub-Saharan Africa remain high, with the region accounting for 70% of maternal deaths,[79] 47% of stillbirths[80] and 46% of neonatal[81] deaths globally.[82] In Kenya, the maternal mortality ratio (MRR)[83] is estimated at 355 per 100,000 live births – 1.8 times higher than the global average of 197. This translates to around 6,000 preventable deaths each year.

These deaths often result from gaps in the quality and continuity of care during pregnancy, childbirth and the postnatal period.[84] Many expectant mothers do not attend the recommended number of antenatal care (ANC)[85] visits and, even when they do, consultations are rushed and lack essential components of care. Critical information on birth preparedness, recognition of danger signs and newborn care is not always effectively conveyed, leaving women underinformed and unprepared for complications.

At the same time, overburdened public health facilities struggle to provide personalised support at scale, and resource constraints limit traditional outreach by community health workers (CHWs). This combination of supply-side gaps (overstretched clinics, staff shortages, limited face-to-face time with skilled health professionals) and demand-side barriers (distance, cost low health literacy) contributes to preventable complications and deaths among mothers and newborns.

About Jacaranda Health

Jacaranda Health is a Kenya-based non-profit organisation founded in 2016 with a mission to improve health outcomes for mothers and infants by leveraging low-cost, scalable technologies.

The company partners with governments to deploy affordable and scalable solutions in government hospitals to sustainably improve the quality of care and maternal and newborn outcomes.

Its flagship programme, PROMPTS (Promoting Mothers and Pregnant Women Through SMS),[86] is a free mobile messaging service that supports women through pregnancy and postpartum. Mothers typically enrol in PROMPTS during antenatal visits at public health facilities, consenting to receive regular health tips, appointment reminders and the ability to ask questions by text.

Organisation profile

Year founded: 2016

Business type: Non-profit

Funding: Philanthropic funding and grants

Team size: About 120 staff (95% based in Kenya)

Geographies: Kenya, Ghana, Nigeria, Eswatini and Nepal

79. UNICEF. (April 2025). "Maternal mortality".
80. A baby who dies after 28 weeks of pregnancy, but before or during birth, is classified as a stillbirth. WHO.
81. Number of deaths during the first 28 completed days of life per 1000 live births in a given year or other period. WHO – The Global Health Observatory.
82. WHO. (7 April 2025). "African region's maternal and newborn mortality declining, but progress still slow".
83. The maternal mortality ratio (MMR) is defined as the number of maternal deaths during a given period per 100,000 live births during the same period. It depicts the risk of maternal death relative to the number of live births and essentially captures the risk of death from a maternal cause in a single pregnancy (proxied by a single live birth). WHO.
84. The postnatal period begins immediately after the birth of the baby and extends up to six weeks (42 days) after birth. WHO Technical Consultation on Postpartum Care.
85. Antenatal care (ANC) can be defined as the care provided by skilled healthcare professionals to pregnant women and adolescent girls to ensure the best health conditions for both mother and baby during pregnancy. WHO Recommendations on Antenatal Care for a Positive Pregnancy Experience.
86. PROMPTS

PROMPTS is complemented by MENTORS,[87] a programme based on a training-of-trainers (ToT) model in which mentors from Jacaranda train and support a cohort of government nurses and midwives to become maternal and newborn health "quality of care champions" in their facilities. Nurses complement their in-person training with DELTA (Digital EmONC Learning Trainer and Assistant), Jacaranda's mHealth learning tool, which offers essential emergency obstetric and newborn care (EmONC)[88] modules remotely via WhatsApp.

For its government partners, Jacaranda offers PULSE,[89] a co-designed dashboard that triangulates real-time data from mothers, providers and facilities into simple formats (e.g. traffic light coding) to monitor performance and reveal gaps. Together, these tools aim to improve the quality of care for every mother and newborn.

Jacaranda Health's PROMPTS programme

Source: Jacaranda Health

Figure 14: The value AI adds to PROMPTS

Access and outreach:
AI enables automated interactions, reaching expectant mothers in resource-constrained settings at scale.

Personalisation:
Tailored advice and support through PROMPTS based on each mother's profile, making the support relevant and effective.

Accuracy:
A human-in-the-loop (HITL) approach using an AI auditor enables the system to provide consistent, evidence-based answers, while routing high-risk or low-confidence responses to the help desk.

Automation and efficiency:
Automated triage and Q&A handling by AI dramatically improves response time and operational efficiency. Help desk can focus on urgent cases while routine queries are resolved instantly.

Systemic:
Data and insights (e.g. dashboards of community health trends), based on interactions with PROMPTS and other sources, inform policymakers and integrate with health systems, fostering a more responsive and data-driven ecosystem.

Source: GSMA (2025)

87. Jacaranda Health
88. EmONC stands for Emergency Obstetric and Newborn Care, defined by the WHO as a critical set of life-saving interventions for severe, life-threatening complications during pregnancy, childbirth and the postpartum period.
89. Jacaranda Health

AI solution and architecture

Jacaranda Health began integrating AI in its PROMPTS digital health platform in 2019 to help manage the growing volume of questions from expectant and new mothers. The initial system used a rule-based ML classification model that automatically triaged incoming messages by scanning for keywords (for example, terms indicating urgent medical conditions like bleeding). The model categorised each message as urgent or non-urgent, allowing the clinical help desk team to prioritise cases requiring immediate follow-up. Over time, this rule-based system was expanded to handle approximately 250 message categories with a high degree of accuracy, creating the foundation of an automated maternal health response pipeline.

Building on this foundation, in 2023 Jacaranda introduced a more advanced LLM architecture. The team fine-tuned Meta's open-source LLaMA model, using more than 1 million anonymised historical question-answer pairs from its help desk database to develop a customised LLM – UlizaLlama[90] – capable of recognising and responding to the informal, bilingual text-messaging patterns common among Kenyan mothers, combining English, Swahili and shorthand text. UlizaLlama is one of the first free-to-use Swahili LLM,[91] and since August 2024 has been fine-tuned for other African languages.

Maternal and neonatal risk is complex, requiring a sensitive and data-driven approach to understand and address it effectively. Often a single message from a mother might not seem urgent on its own, yet patterns across her messaging history can reveal emerging risks that warrant closer attention. These signals are often subtle, and traditional keyword-based systems or manual reviews can easily miss them. Escalations can occur at any point within 200 days of a mother's enrolment on the platform, with no clear geographical patterns, and affect only about 12% of all PROMPTS users.[92] Identifying risk patterns through general observations is not an ideal solution. To overcome this, Jacaranda applies ML to help predict and manage potential escalations. A Random Forest[93] ML model analyses each user's interaction history alongside short profiling questions asked during enrolment and at key milestones. For example, *"Do you have any existing health conditions such as diabetes?"* This enables the system to stratify users by risk and estimate the likelihood of escalation. Beyond improving triage, this approach also enhances personalisation. The platform's message scheduler dynamically adjusts the timing and content of messages based on each mother's unique profile and stage of pregnancy or postpartum journey, ensuring that the advice provided is timely, relevant and responsive to individual needs.

To ensure safety and reliability, Jacaranda employs a human-in-the-loop (HITL)[94] design that combines GenAI and automation with clinical oversight. Each response generated by the UlizaLlama LLM is reviewed by a secondary "auditor" LLM for correct grammar, clarity, coherence and medical accuracy. The auditor LLM assigns a confidence score and flags potential issues. Messages with a low confidence score or identified as urgent (e.g. those mentioning heavy bleeding, fainting or severe pain) bypass the automation entirely and are routed directly to Jacaranda's 24/7 clinical help desk. Help desk agents then respond personally via SMS or phone call, advising mothers to seek immediate care when needed. This layered system enables the solution to scale while maintaining a robust human safety net for high-risk situations.

Beyond conversational AI, Jacaranda leverages the continuous data streams from PROMPTS and MENTORS to strengthen health systems and inform decision-making. Data on common questions, referral rates and mothers' self-reported service experiences feed into interactive dashboards co-developed with Ministry of Health and county health teams. These dashboards, called PULSE, provide real-time insights, such as identifying facilities experiencing increases in specific danger signs or communities with low postnatal care (PNC)[95] clinic attendance. County managers have access to indicators including missed blood pressure checks and postpartum family planning uptake, enabling evidence-based supervision and continuous quality improvement.

90. Jacaranda Health. (31 October 2023). "Jacaranda launches first-in-kind Swahili Large Language Model".

91. Hugging Face

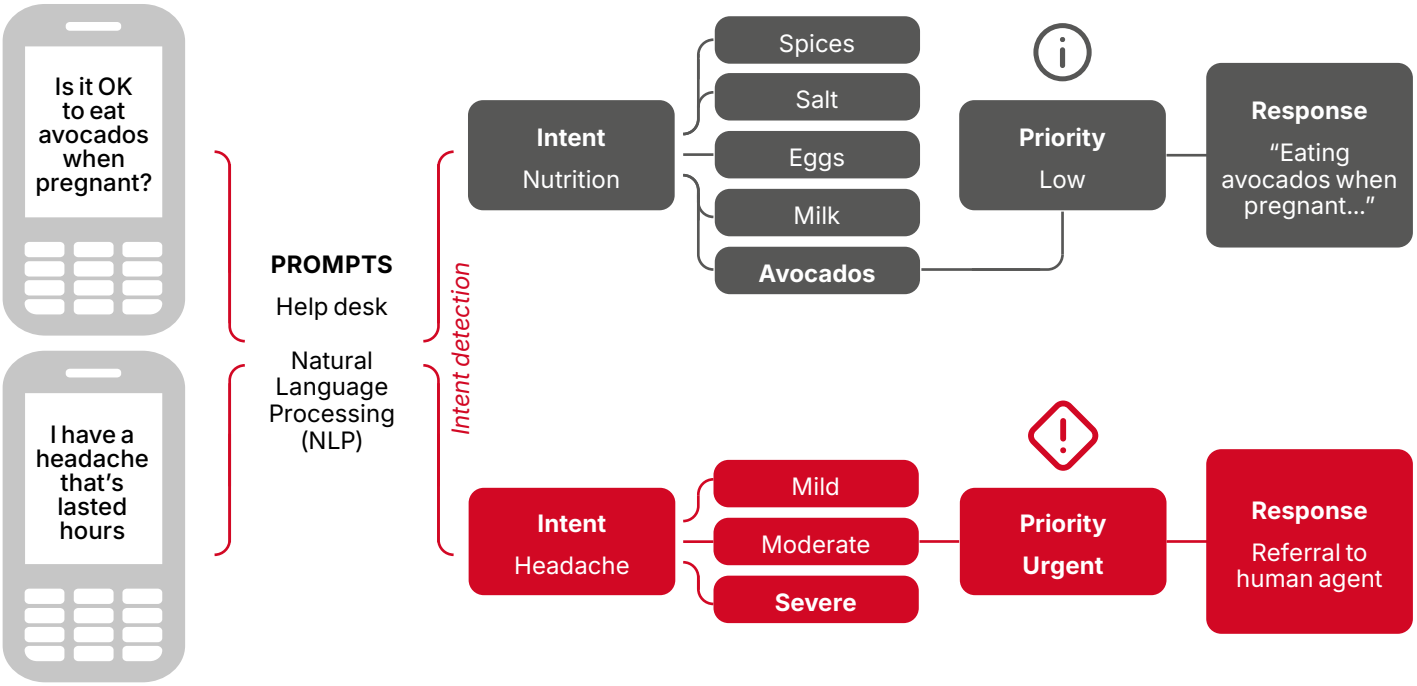
92. Jacaranda Health. (13 June 2024). "Can we develop predictive models that provide insight on maternal risk from conversational patterns?"

93. Kavlakoglu, E. (n.d.). "What is random forest?" IBM.

94. Human-in-the-loop (HITL) refers to a system or process in which a human actively participates in the operation, supervision or decision-making of an automated system. IBM.

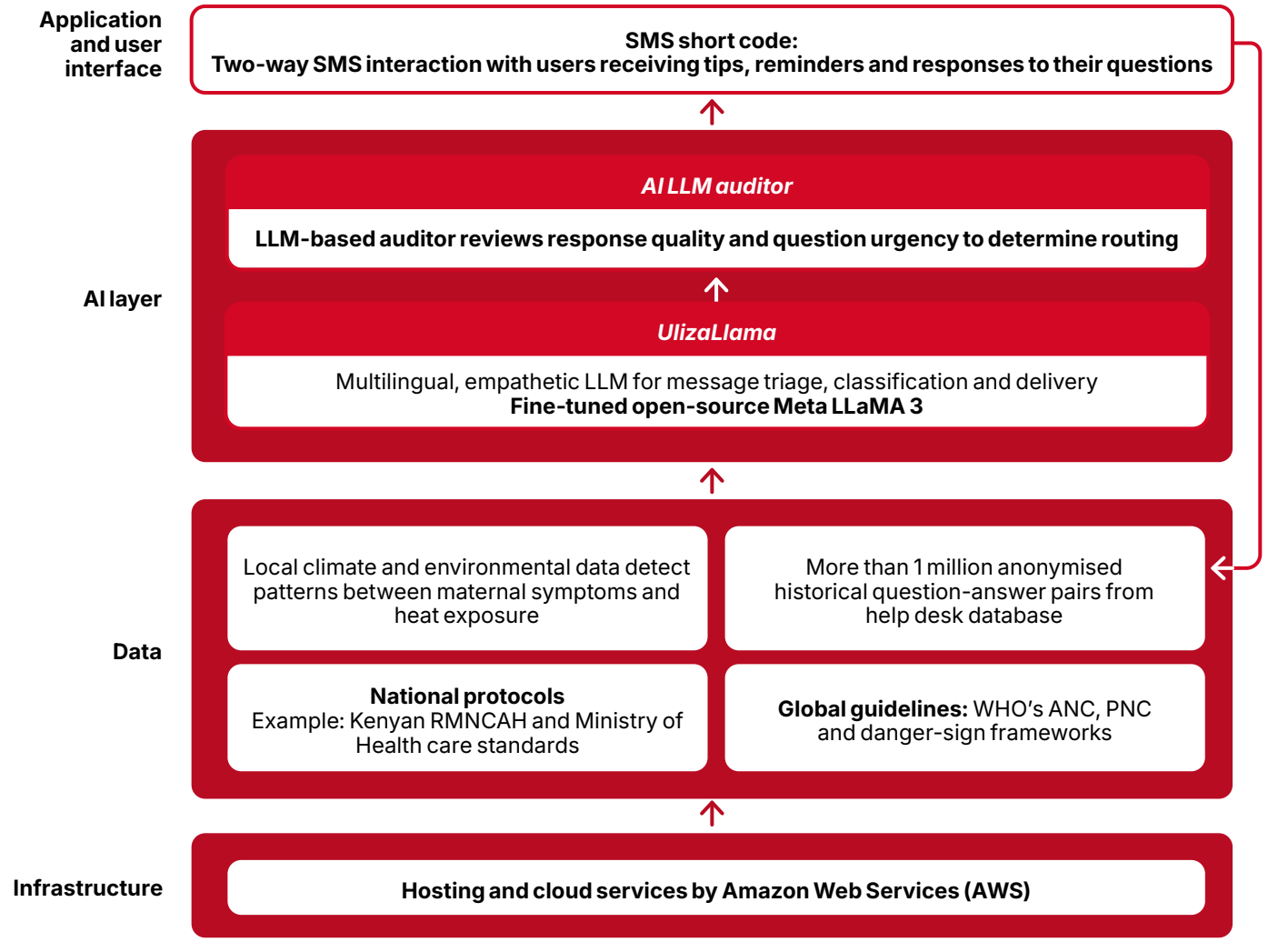
95. Postnatal care refers to the healthcare provided to mothers and their babies after childbirth, focusing on promoting well-being and addressing both maternal and infant health issues. ScienceDirect.

Figure 15: How PROMPTS works



Source: Jacaranda Health[96]

Figure 16: PROMPTS AI architecture and data flow



Source: GSMA (2025)

96. Jacaranda Health. (2023). PROMPTS brochure.

Technology profile	
Type of AI:	Predictive AI, GenAI
Type of technology used:	ML, predictive analytics, NLP
Main users:	Expectant mothers, mothers of newborns, public health institutions, CHWs, midwives, county health managers
Delivery channels:	SMS short code (for mothers), WhatsApp (CHWs and midwives), live web dashboards (public health institutions and county health managers)
Technology partners:	Meta Llama, Amazon Web Services (AWS)

Business model

Jacaranda Health operates as a non-profit, asset-light social enterprise that delivers value to both mothers and public health systems. Through close collaboration with national and county health authorities, its digital solutions are seamlessly integrated in public health systems, where mothers are enrolled during ANC and PNC visits. Its primary users are low-income mothers and infants served by public facilities who receive free, trusted health advice and reminders tailored to their pregnancy or postpartum stage, helping them recognise danger signs, attend check-ups and ensure timely newborn immunisations. Institutional partners, including government clinics and county health teams, use Jacaranda's training platforms and data tools to improve service delivery, build staff capacity and monitor performance in real time.

The operating costs are driven by personnel and technology, including SMS delivery, server infrastructure and help desk operations. Jacaranda relies on funding from philanthropic organisations and international partners such as Mulago Foundation[97] and the Gates Foundation,[98] which support operations, innovation and impact evaluation. Over time, Jacaranda has integrated blended financing[99] in its business model, with county governments and national ministries of health co-funding activities such as mothers' enrolment and nurse and midwife training. This combination of donor and public-sector support enhances sustainability, allowing Jacaranda to reinvest the efficiency gains from AI and automation to expand reach, personalise content and improve maternal and neonatal outcomes at scale.

Impact and results

Jacaranda's interventions have demonstrated a positive impact on both individual health behaviours and health system performance. An independent research study, including a large cluster randomised controlled trial (RCT) in Kenya, followed more than 6,000 women across 40 health facilities, half of which introduced PROMPTS to their patients.[100] The study found that PROMPTS led to modest but meaningful improvements in pregnant and postpartum women's knowledge, birth preparedness and routine care-seeking behaviours across several counties in Kenya. It notably increased newborn care practices and the quality of postpartum care mothers received, such as family planning counselling and physical exams. The tool also showed promise in complementing existing health services, especially improving care during the postpartum period, highlighting the potential of low-cost, large-scale digital platforms to support maternal and newborn health in low-resource settings.

97. Mulago Foundation
98. Gates Foundation
99. World Bank Group. (n.d.). "Blended Finance".
100. Vatsa, R. et al. (2025). "Impact evaluation of a digital health platform empowering Kenyan women across the pregnancy-postpartum care continuum: A cluster randomized control trial". *PLOS Medicine*.

Figure 17: Jacaranda Health business model canvas

Key partnerships

- **Government:** Ministry of Health and county health departments (service deployment, scale up, cost sharing)
- **Donors and NGOs:** e.g. USAID, Gates Foundation, Grand Challenges (funding and strategic guidance); research partners (Harvard, WHO for **evaluations)**
- **Telecoms:** SMS aggregators
- **Tech companies** (Meta for LLM technology support, Google.org for AI fellowship)

Key activities

- Developing and updating digital content (health messages, AI training data)
- Running the AI-enabled help desk (monitoring AI responses, triaging queries, making outbound calls)
- Training health workers and supporting facility onboarding
- Maintaining partnerships (government liaison, donor reporting)

Value propositions

- **For mothers:** Free, personalised maternal health guidance and 24/7 Q&A support via mobile phone, leading to safer pregnancies and newborns
- **For health providers:** On-demand training and decision support, reducing workload and improving quality of care
- **For health system:** Higher antenatal/postnatal attendance, data visibility on service gaps and improved maternal-newborn outcomes at low cost

Customer relationships

- **Mothers:** Trust-based, proactive and ongoing; service is introduced by a familiar nurse (building trust), then sustained via frequent interactive SMS
- **Health officials:** Collaborative partnership; Jacaranda embeds within government programmes, provides regular data updates

Customer segments

- **Primary:** Low-income pregnant women, mothers and newborns served by public facilities (end users of PROMPTS messages and support)
- **Secondary:** Public health sector institutions (government clinics, county health managers) that adopt the solutions to improve service delivery

Channels

- Enrolment: In-person at antenatal clinics (health workers register mothers in PROMPTS); community health volunteers
- Service delivery: SMS text messages (primary channel for tips, reminders, and chatbot Q&A); phone calls (help desk calls for urgent cases)

Key resources

- Custom technology platform (PROMPTS software, AI models, SMS gateway integration)
- Extensive Q&A database and culturally tailored health content library
- Skilled team: help desk, tech staff and programme managers
- Relationships and integration with public health infrastructure

Revenue streams

- **Grants and donations:** Primary source of funding (philanthropic grants, innovation awards, research grants) – covers development and expansion
- **Government co-funding:** Increasing contribution from Kenyan government (e.g. covering about 60% of training programme costs, subsidising SMS costs in some counties)
- **In-kind support:** e.g. Google Fellowship (expert time) *(No direct charges to end users; service is free for mothers)*

Cost structure

- **Service delivery costs:** SMS messaging fees (large volume of texts sent daily), call centre operations (staff salaries, telecoms costs)
- **Tech infrastructure:** Cloud server and AI model hosting, software development and maintenance
- **Programme implementation:** Training materials for health workers, supervision visits, monitoring surveys

Source: GSMA (2025)

Jacaranda reports improvements in health-seeking behaviour among PROMPTS participants in Kenya, where 95% of mothers delivered with a skilled birth attendant, compared to 66% nationally. They also achieved higher completion of the World Health Organization's (WHO) recommended four antenatal visits – 91% compared to about 66% baseline.[101] There has also been a 100% increase in mothers using postpartum family planning services. The use of GenAI has also significantly improved average response times for users (about 10–15 mins versus 2–4 days).

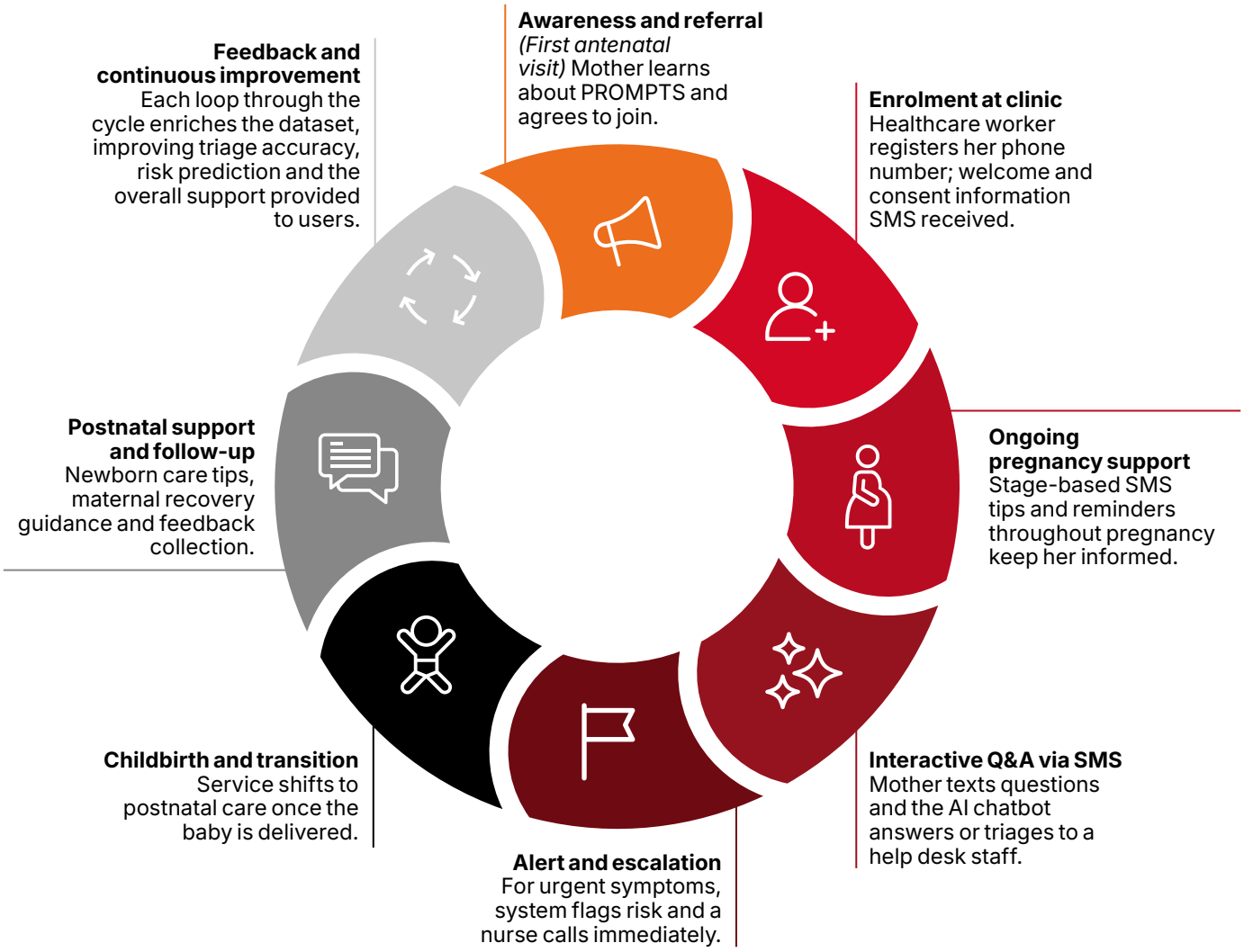
As of early 2025, Jacaranda has enrolled more than 3.32 million mothers to PROMPTS, responded to more than 12,000 questions daily and automatically addressed about 70% of all questions, particularly low-risk, informational messages about pregnancy and newborn care. Through its MENTORS initiative, Jacaranda has also trained more than 10,000 healthcare providers.[102]

3.32M
mothers enrolled to PROMPTS

12K QUESTIONS RESPONDED TO DAILY

70%
questions addressed automatically

Figure 18: PROMPTS user journey



Source: GSMA (2025)

101. Jacaranda Health. (2024). *2024 Annual Impact Report*.
102. Jacaranda Health. (2025). *Q2 Impact Report*.

Challenges and future outlook

Jacaranda Health faces several strategic and operational challenges as it scales its maternal health innovations. A key issue is maintaining personalisation and quality at scale. Expansion to new countries and regions introduces linguistic and cultural variations that require access to local datasets and retraining of models. For instance, Swahili varies considerably across East African countries. Likewise, languages such as Twi in Ghana and Hausa in Nigeria, both new to Jacaranda's digital platform, require new datasets and partnerships for effective contextual adaptation. Jacaranda's data cleaning and augmentation toolkit developed in Kenya offers a strong foundation but replicating it elsewhere requires investment and local expertise.

Sustaining integration and financial viability also poses difficulties. While donor support has fuelled growth, long-term sustainability depends on embedding PROMPTS in government systems and budgets. The Kenyan government has begun cost sharing, yet national health budgets are constrained and subject to shifting political priorities. Jacaranda is exploring cost-sharing arrangements and private-sector collaboration, such as partnerships with MNOs to offset messaging costs through corporate social responsibility (CSR) programmes or bundled telehealth services. These models could support continuity while preserving the platform's neutrality and trust.

Technologically, Jacaranda is moving towards accessible AI for low-literacy populations and recently launched a Swahili-speaking voice alternative to engage low-literacy and sight-impaired mothers who are otherwise cut off from life-saving health information. Early results show promise – 30% of mothers who had not previously opted into PROMPTS did so after receiving a voice call. The team is currently experimenting with different accents and dialects from across Kenya to ensure the voices are familiar and relatable to the mothers they serve, with plans to roll out the voice-based Q&A version of PROMPTS by the end of 2025.

Integration with national health systems is another ongoing priority. Connecting PROMPTS to government health information systems could allow for more personalised communication, such as sending reminders based on missed clinic appointments. However, challenges like weak or missing digital infrastructure and lack of data interoperability continue to hinder progress. To ensure Jacaranda's solutions are incorporated sustainably in public sector workflows, ongoing engagement and capacity building within the public sector is essential.

Jacaranda plans to deepen its use of adaptive AI capable of multilingual response generation and context-aware assistance for health workers. The company plans to layer climate data in PROMPTS to strengthen its predictive and preventative health messaging for mothers with support from The Rockefeller Foundation.[103] Layering climate data will enable Jacaranda to align with national climate adaptation programmes and deliver real-time guidance during extreme weather events, advising mothers on hydration and rest during heatwaves.[104]

Jacaranda has also partnered with Google[105] to conduct exploratory research to understand the current approach to ultrasound delivery in Kenya and explore how new AI tools could support point-of-care ultrasound for pregnant women.

Through its Principles for Responsible, Person-Centred AI,[106] Jacaranda Health continues to champion ethical and inclusive design. Over the next five years, it aims to institutionalise these digital maternal health models as standard components of national healthcare systems in East and West Africa, advancing progress on global maternal and neonatal healthcare goals.

103. Rockefeller Foundation
104. Hamilton, M. (13 March 2025). "AI Meets Motherhood to Bridge the Information Gap in Africa". Rockefeller Foundation.
105. Levavi Morad, R. and Singh P. (8 March 2024). "How AI is helping advance women's health around the world". Google.
106. Jacaranda Health. (15 December 2023). "Jacaranda's Principles for Responsible, Person-Centered AI".

Case study: **LifeBank**

Context

Postpartum haemorrhage is the leading cause of maternal mortality in Africa. It is a condition in which women continue to bleed excessively after childbirth and requires urgent intervention within 20 minutes to four hours. While the global maternal mortality ratio stands at 197 deaths per 100,000 live births,[107] Nigeria has a rate of 993 deaths per 100,000 live births, the highest in the world.[108] The challenge is unpredictable and systemic, with no clear medical indication of which women will need urgent intervention.

Preventable deaths from postpartum haemorrhage, childhood pneumonia, respiratory diseases and medical emergencies are driven by shortages of essential medical supplies such as blood, oxygen and vaccines in LMICs. Health facilities often lack visibility into stock levels, data on demand trends or reliable mechanisms to request and receive timely deliveries, particularly in rural or under-resourced settings. These gaps contribute to critical delays in emergency care and reinforce systemic inefficiencies.

About LifeBank

LifeBank is a health logistics company based in Nigeria that uses digital platforms and on-demand delivery networks to connect hospitals and clinics with verified suppliers of life-saving products. The company started with blood distribution and has expanded to include oxygen, medical consumables[109] and other critical health commodities, leveraging AI and digital infrastructure to strengthen supply chains and enable timely access to life-saving products in resource-constrained settings.

Motorbike dispatcher for LifeBank prepares for a delivery

Source: LifeBank

Organisation profile

Year founded: 2016

Business type: For profit

Stage: Growth

Funding: Grants, venture capital funding

Team size: About 150

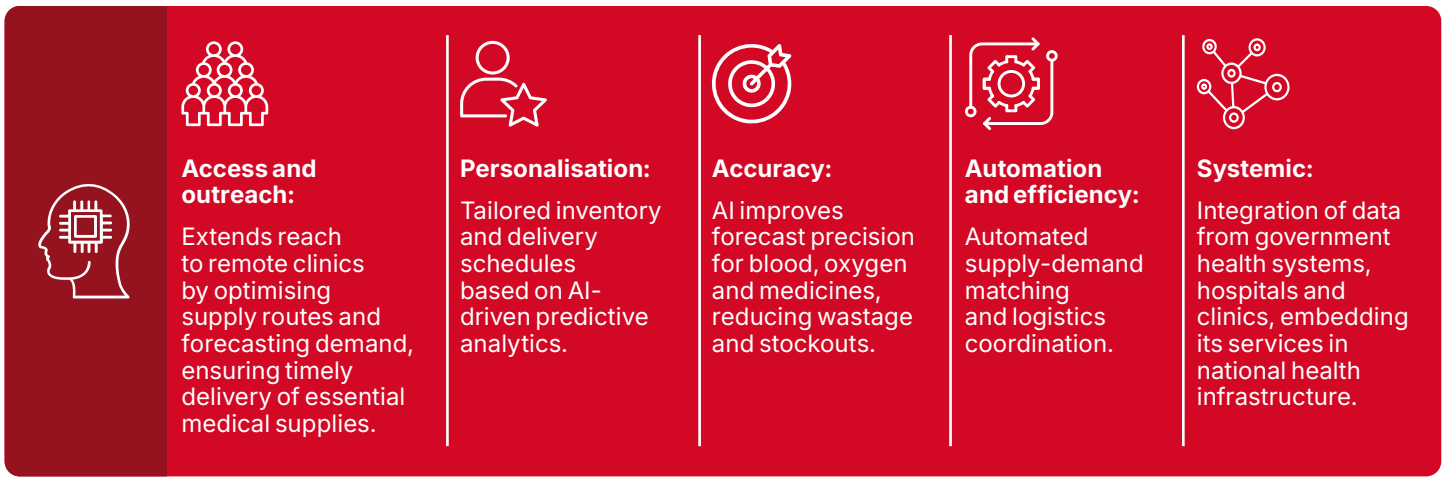
Geographies: Nigeria, Kenya, Ethiopia and Sierra Leone

107. WHO. (2025). "Maternal mortality".

108. World Bank Gender Data Portal: Nigeria.

109. Medical consumables are single-use or limited-use items essential for patient care, hygiene and medical procedures, including bandages, gloves, syringes, masks and wound dressings, which are typically disposed of after use to prevent infection and ensure effective treatment.

Figure 19: The value AI adds to LifeBank



Source: GSMA (2025)

AI solution and architecture

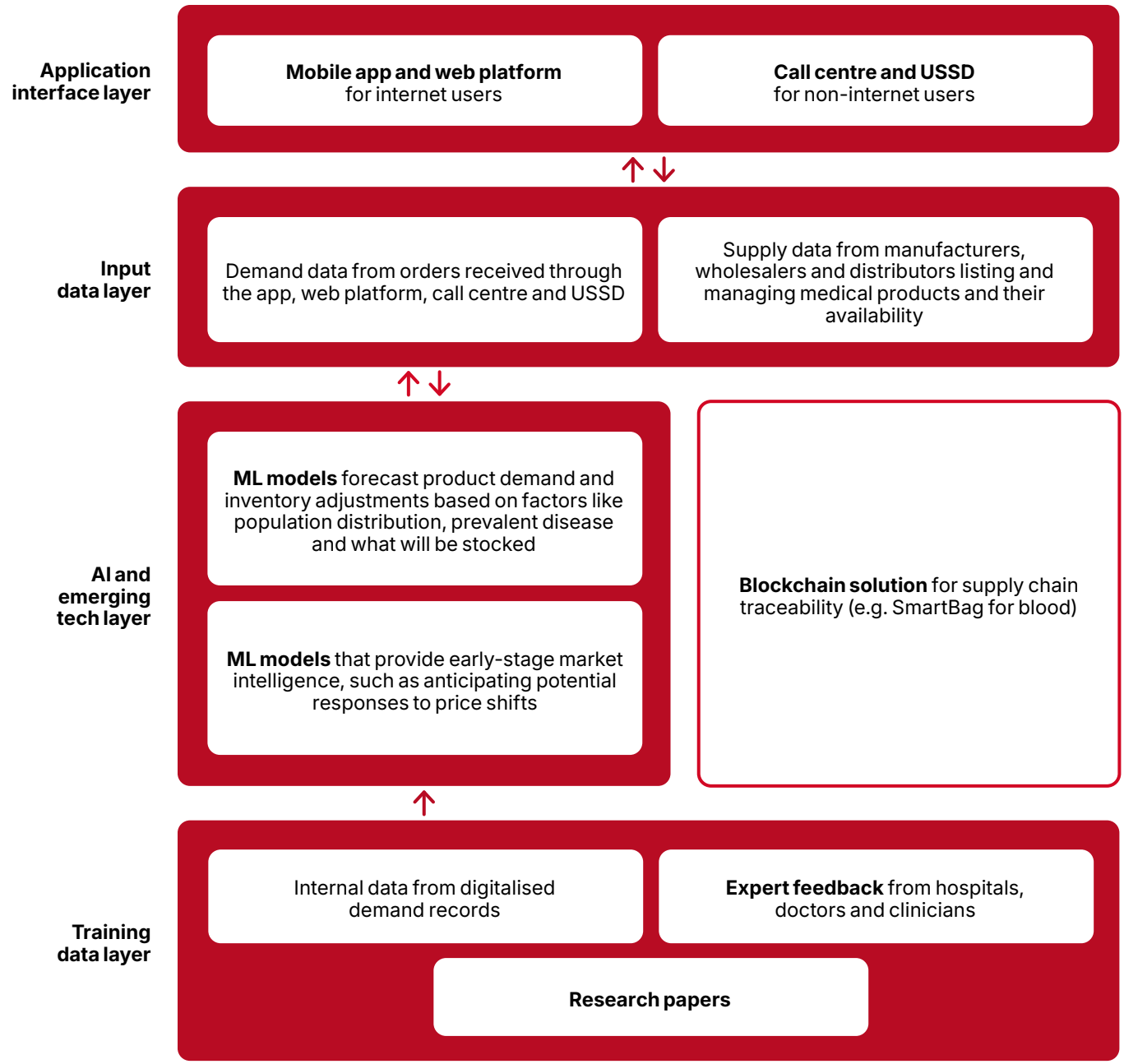
LifeBank's AI-enabled supply chain platform is designed to meet the complex and fragmented logistics challenges of health systems in low-resource settings. The solution integrates health facility ordering systems, vendor tools and a multimodal logistics fleet, all connected through a unified technology stack. This ecosystem enables hospitals and clinics, many of which lack formal inventory management systems, to place orders, track stock levels and receive deliveries in real time via a mobile app or call-based support channel.

At the core of the platform, LifeBank (in partnership with benshi.ai,[110] a digital health AI startup based in Spain) has developed predictive inventory models that use ML techniques to forecast demand and anticipate stock needs for critical medical supplies such as blood, oxygen and vaccines. These models are trained on internal digitalised demand data, expert feedback from health workers and external data sources such as population distribution, disease prevalence and research. In addition to demand prediction, AI models generate early-stage market intelligence by flagging potential risks such as price volatility, enabling vendors to better anticipate shifts in supply and demand.

To enhance transparency and trust in the supply chain of blood products, LifeBank integrates blockchain technology in its own logistics system – SmartBag Tag[111] – to track donation date, screening, blood group and safety records, ensuring blood units are traceable from donor to transfusion, with information accessible via web app or USSD (for feature phones). This is further supported by cloud-based infrastructure and external APIs (e.g. Google Maps API[112] technology), enabling optimised route planning and journey tracking and ensuring timely delivery, even in remote areas.

110. Benshi AI
111. SmartBag Tag is a blockchain-powered product that helps patients and healthcare providers discover the safety record of blood. LifeBank.
112. Google Maps Platform Documentation

Figure 20: LifeBank AI architecture and data flow



Source: GSMA (2025)

Technology profile

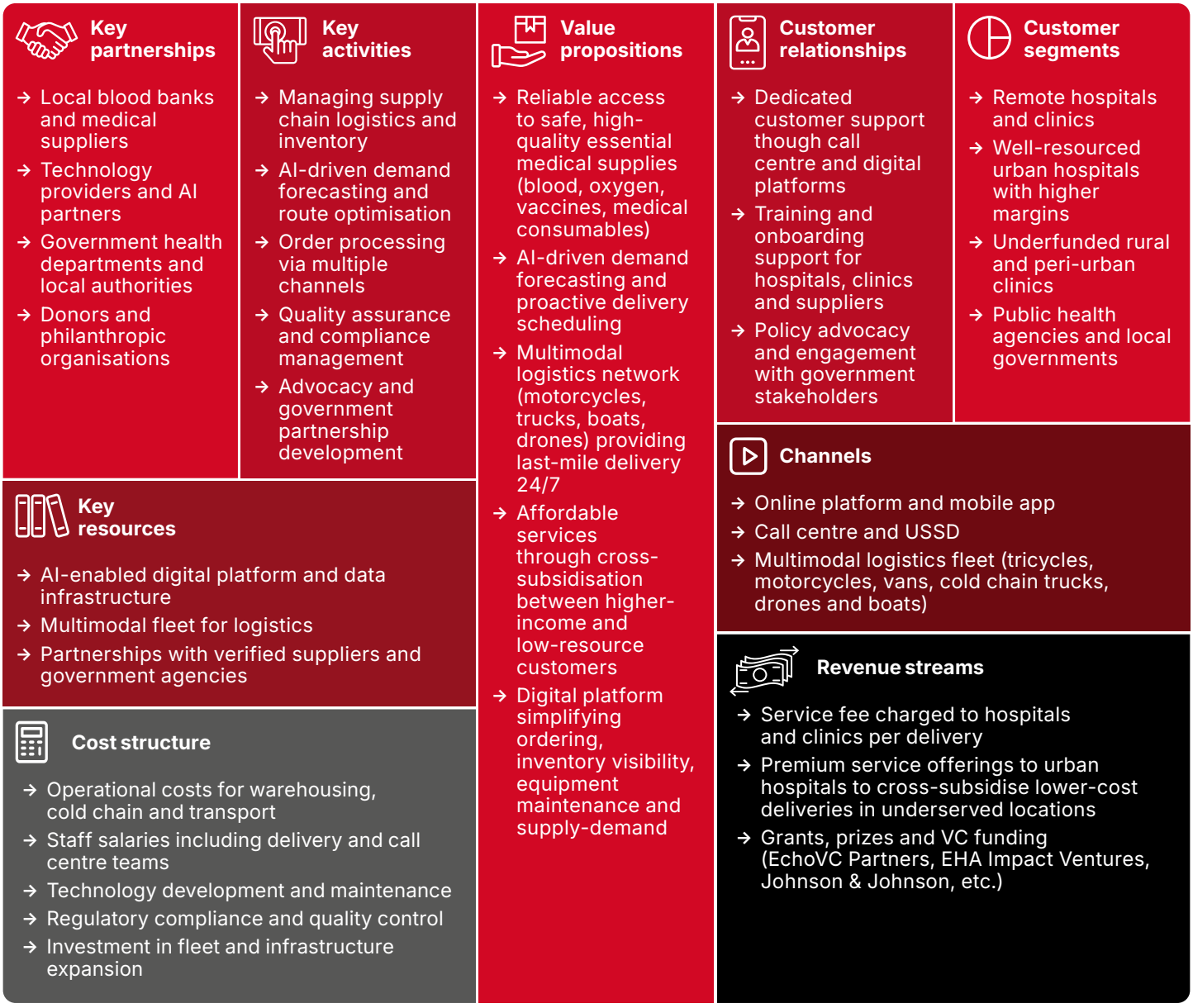
Type of AI:	Predictive AI
Type of technology used:	ML, blockchain
Main users:	Hospitals and health facilities (public and private), blood banks and suppliers, rural clinics
Delivery channels:	Mobile app, web platforms, call centre and USSD

Business model

LifeBank operates a B2B model, partnering directly with hospitals and clinics to ensure critical medical supplies are available when patients need them, and generating revenue through service fees for each successful delivery. It runs a digital platform that connects hospitals' demands for blood, oxygen and a range of medical products including medical consumables, with a marketplace of suppliers. While LifeBank does not own most of the supplies it delivers, it ensures quality and safety through licensing and enforcement of stringent safety standards. The company operates one medical oxygen plant in a high-demand area and aggregates inventory from verified suppliers to meet hospital and clinic demand.

The company relies primarily on a multimodal delivery fleet that includes motorcycles, tricycles, trucks, boats and, in some cases, helicopters and drones, offering round-the-clock dispatch via a mobile app and call centre to reach even the most remote healthcare facilities. The most consistently successful and widely used modes of delivery are motorcycles, which can navigate urban congestion and deliver small, urgent supplies rapidly, and trucks, which are suitable for larger items such as oxygen cylinders. Boats are a critical mode of delivery to reach riverine, hard-to-access rural communities. While drones are promising for remote areas, LifeBank has faced considerable challenges in scaling them as a delivery channel due to regulatory complexities and high costs.

Figure 21: LifeBank business model canvas



Source: GSMA (2025)

To keep its services affordable for low-resource settings, LifeBank uses a cross-subsidisation strategy. Higher-margin offerings to well-resourced urban hospitals help offset lower-cost services to underfunded clinics. LifeBank, through its Blood Safety Fund project, provides zero-interest loans to blood banks for business investment and service improvement, such as purchasing appropriate blood refrigerators. Loan repayment is made through blood collection and supplying local healthcare facilities.

The company receives financial support from both venture capital and philanthropic donors and is approaching long-term financial sustainability.

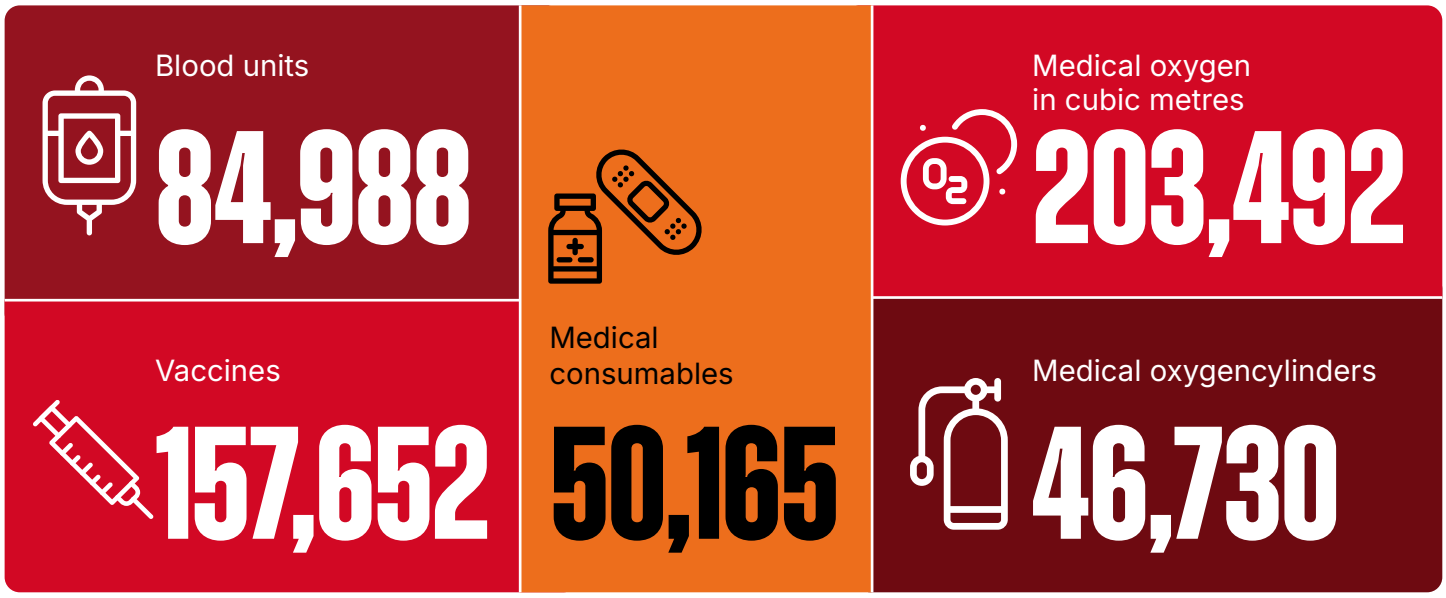
Impact and results

LifeBank's AI-driven logistics platform enhances access to essential medical supplies across Nigeria and other African countries, including Kenya, Ethiopia and, most recently, Sierra Leone. The company's geographic expansion is strategically focused on countries facing similar urgent health challenges, such as critical shortages in medical supply chains and high maternal mortality rates. In addition to addressing fragmented health supply chains and demand for life-saving medical supplies, LifeBank also considers factors such as opportunities to collaborate with governments, ministries of health and donor-funded maternal health programmes when selecting expansion markets.

Operating in more than 3,000 hospitals and clinics, LifeBank uses predictive analytics on real-time data to match supply and demand for blood, oxygen and medical consumables. This has helped healthcare providers manage inventory efficiently and prioritise urgent deliveries, reducing delays in critical and emergency care.

Since its inception, LifeBank has delivered more than 340,000 medical products, saving more than 240,000 lives across 13 African cities and significantly reducing maternal mortality linked to blood shortages. LifeBank's multimodal fleet enables timely delivery to remote and hard-to-reach locations.

Figure 22: Medical products delivered by LifeBank



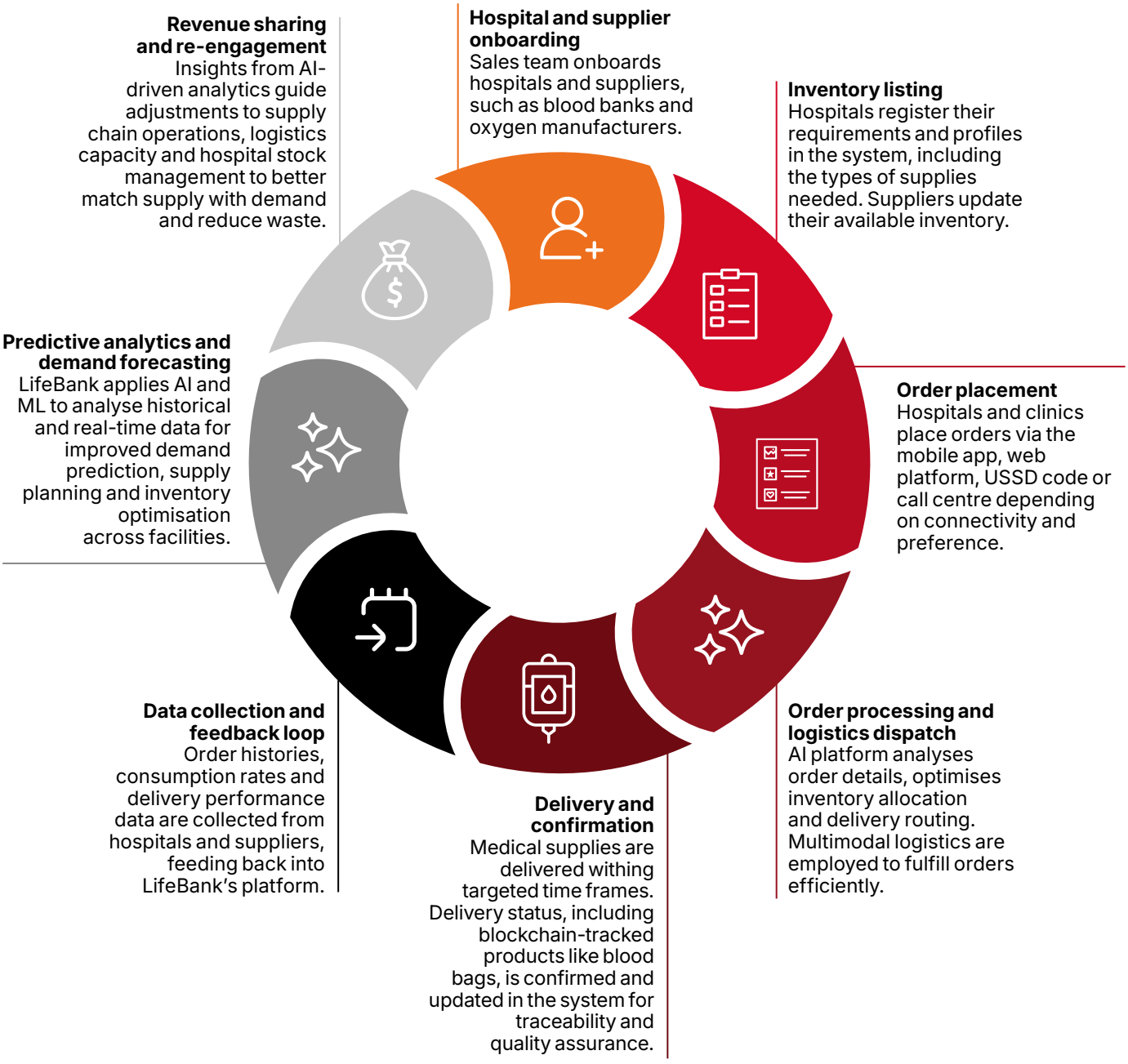
Partnerships for impact

In partnership with Oxygen Hub, an Institute of Transformative Technologies (IIT) initiative that works with local business partners in Sub-Saharan Africa to build a network of local entrepreneurs who produce and distribute affordable, sustainable medical oxygen, LifeBank launched a 700 cubic-metre (m3) per day medical oxygen plant in Orozo, Nasarawa State (north-central Nigeria), to address critical shortages of medical oxygen in the region. This collaboration enabled the delivery of more than 150,000 m3 of medical oxygen to hospitals in the region, significantly enhancing emergency health services.

Building on this infrastructure, the company partnered with the Nasarawa State Investment and Development Agency (NASIDA)[113] and Nasarawa State Ministry of Health to deploy an AI-driven forecasting tool that digitalises oxygen demand in public hospitals. The partnership has enabled health facilities to better predict and manage oxygen needs, reducing stockouts, cutting distribution costs and improving patient outcomes.

These partnerships in Nasarawa illustrate LifeBank's integrated approach to combining production capacity, AI-driven planning, last-mile logistics and ecosystem partnerships, which the company is now looking to implement across other Nigerian states.

Figure 23: LifeBank user journey



Source: GSMA (2025)

113. NASIDA: https://nasida.na.gov.ng/

Challenges and future outlook

LifeBank is now a pan-Nigerian company, reaching almost all healthcare providers in the country. However, scaling beyond Nigeria into other African countries is hindered by a combination of regulatory barriers, capital constraints and operational complexity.

Regulatory barriers

As a company at the intersection of healthcare delivery and logistics, LifeBank operates in a complex regulatory environment. The distribution of critical medical supplies like blood, plasma and oxygen is subject to stringent national regulations governing licensing, testing, quality assurance and cold-chain management. Obtaining the necessary licences and approvals to operate blood storage and transport systems is time-consuming and often complicated by fragmented regulatory frameworks that differ from one country to another.

LifeBank also faces regulatory challenges outside its home market of Nigeria, as securing licences, building trust with public health authorities, explaining an unfamiliar for-profit business model and securing operational legitimacy for handling sensitive medical products requires time, investment and continuous engagement.

Regulators also require validated testing (for HIV, hepatitis B/C, syphilis and other transfusion-transmitted infections), donor-screening protocols, traceability and haemovigilance.[114] Weak national systems and high prevalence of transfusion-transmitted infections (TTIs)[115] increase regulatory scrutiny and operational complexity.

In parallel, LifeBank must manage clinical governance and liability risks. Mistakes in blood matching, contamination during handling or oxygen supply failures can result in patient harm and legal consequences. As such, the company invests in robust training, documentation and quality systems to align its operations with hospital standards and public health regulations. Yet, the uneven enforcement of healthcare regulations across African markets continues to pose operational uncertainty, often delaying expansion and increasing compliance costs.

Operational and infrastructure challenges

LifeBank's operations are deeply affected by the infrastructural realities of the markets it serves. Many of the regions where the company operates suffer from unreliable electricity supply, poor road networks and limited access to cold-chain facilities, all of which can undermine the timely and safe delivery of medical supplies. Managing a mix of digital platforms and non-internet ordering channels like USSD and call centres adds operational complexity.

LifeBank aims to become a one-stop shop for healthcare providers, offering reliable access to safe, high-quality and affordable medical supplies everywhere they are needed in Africa. A central element of LifeBank's immediate strategy is the integration of AI across its operations: improving demand prediction capabilities to move from solely reactive (on-demand) supplies to proactive scheduled delivery, matching inventory to requests more efficiently and reducing wasted time, inventory expiry and last-mile costs.

Beyond being a medical supply marketplace across Africa, LifeBank aims to strengthen the capabilities of healthcare facilities through embedded finance, digital operational tools and training, building more resilient health systems to serve the millions of Africans who depend on reliable medical supply chains.

LifeBank can increase its impact by developing partnerships with donors to cross-subsidise its services and make them more affordable for low-resource facilities while remaining financially sustainable. Collaborations with academic and research institutions can strengthen evidence generation, enabling rigorous evaluation of LifeBank's model and demonstrating its value in improving health outcomes and supply chain efficiency. Partnerships with healthtech platforms and digital infrastructure providers such as logistics, payments and data interoperability systems can accelerate the integration of LifeBank's operations in national health ecosystems. Together, these collaborations can position LifeBank as a trusted partner of governments in strengthening last-mile delivery of critical medical supplies across the continent.

114. WHO. (n.d.). "Haemovigilance", Health products policy and standards.

115. A transfusion-transmitted Infection (TTI) is an infection that a recipient contracts after receiving a blood component, where the infection is confirmed to originate from the transfused material because the recipient had no evidence of the infection before the transfusion and no other source of infection was identified.

Case study: **Khushi Baby**

Context

Community health workers (CHWs) play a vital role in extending essential health services to under-resourced and remote communities. Globally, they have made significant contributions to poverty alleviation, food security and reducing health inequalities. India has almost 3.5 million CHWs in three main cadres: Auxiliary Nurse-Midwives (ANMs),[116] Accredited Social Health Activists (ASHAs)[117] and Anganwadi Workers (AWWs).[118]

Among these, India's nearly 1 million[119] ASHA workers represent the largest cohort of CHWs in the world. This all-women workforce serves as the critical link between local communities and the public health system, ensuring last-mile delivery of essential healthcare services. ASHA workers play a central role in maternal and child health, immunisation campaigns, family planning and disease prevention, often serving as the first point of contact for healthcare in remote and underserved regions. They are often overstretched, working in low-resource environments with limited access to real-time decision-support tools, and spend a significant amount of time on manual recording, duplicating records across registers and multiple siloed mobile portals. This labour-intensive reporting leads to data fragmentation and unreliable data quality.

Meanwhile, health administrators face the challenge of converting fragmented health data into actionable insights to allocate resources effectively, monitor coverage and address emerging public health risks.

About Khushi Baby

Khushi Baby is a 10-year-old non-profit organisation with expertise in building solutions for Ministries of Health. Khushi Baby develops AI-integrated digital health tools designed with and to support frontline health workers and system-level decision-making. Its solutions are embedded within state government health systems in India and use AI to provide real-time support for CHWs and data-driven planning for health administrators.

Organisation profile

Year founded: 2014

Business type: Non-profit

Funding: Philanthropic, multilateral and private-sector grants

Team size: About 120

Geographies: India – Rajasthan (Northwest India), Maharashtra (West India) and Karnataka (South India)

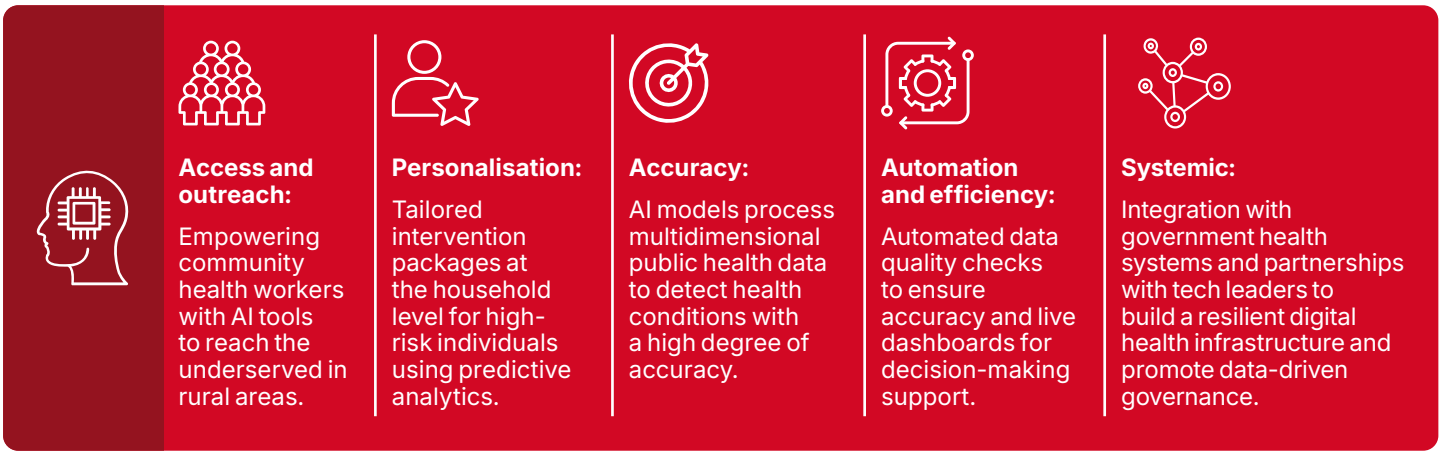
116. An Auxiliary Nurse Midwife (ANM) is a village-level female health worker in India who acts as the first point of contact between the community and health services, providing essential maternal and child healthcare, health education and treatment for minor ailments.

117. Accredited Social Health Activist (ASHA) workers are community health volunteers in India, selected from the community to be a link between the public health system and the people they serve, particularly in rural areas. https://phd.maharashtra.gov.in/en/scheme/accredited-social-health-activist-asha/

118. Anganwadi health workers (AAWs) are CHWs in India who provide essential health, nutrition and early childhood care services to women and children under the country's Integrated Child Development Services (ICDS) programme.

119. Shanthosh, J., Durbach, A. and Joshi, R. (2021). "Charting the Rights of Community Health. Workers in India: The Next Frontier of Universal Health Coverage". *Health and Human Rights Journal,* 23(2).

Figure 24: The value AI adds to Khushi Baby



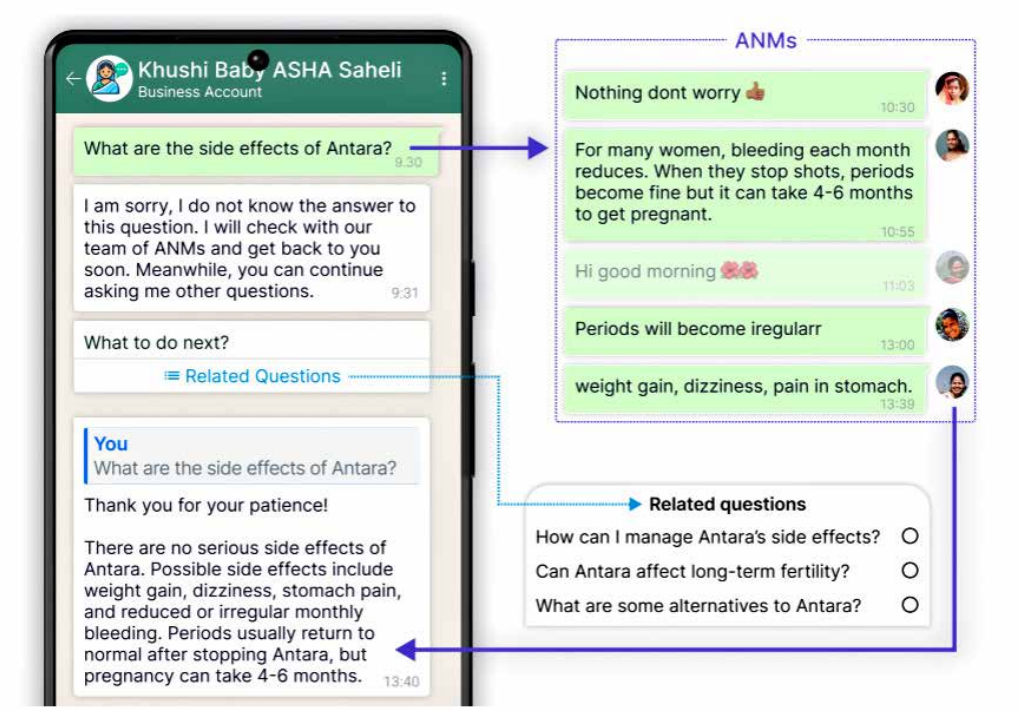
Source: GSMA (2025)

AI solution and architecture

Khushi Baby's AI solution is integrated in its Community Health Integrated Platform (CHIP), a unified digital infrastructure that connects data from frontline workers, healthcare facilities and system-level administrators. The platform combines multiple AI capabilities to support real-time, data-informed decision-making across the public health system.

At the front end, Khushi Baby has developed a multilingual LLM-based WhatsApp chatbot for ASHA workers called ASHABot.[120] ASHABot delivers context-aware triage support and follow-up guidance in both text and voice formats, tailored to local languages and connectivity conditions. When ASHABot cannot answer a question using its knowledge base, it sends that question to multiple ANMs. It identifies relevant information from their responses and generates a consensus answer, which it sends back to the ASHABot (see Figure 25). The system is optimised for use on smartphones with 3G or higher connectivity, ensuring functionality in last-mile environments.

Figure 25: ASHABot with ANMs in the loop



When *ASHABOT* cannot answer a question using its knowledge base, it sends that question to multiple ANMs. It identifies the relevant information from their responses and generates a consensus answer, which it sends back to the ASHA. While we present this example in English, we note that all ASHAs and ANMs interacted with *ASHABOT* in Hindi.

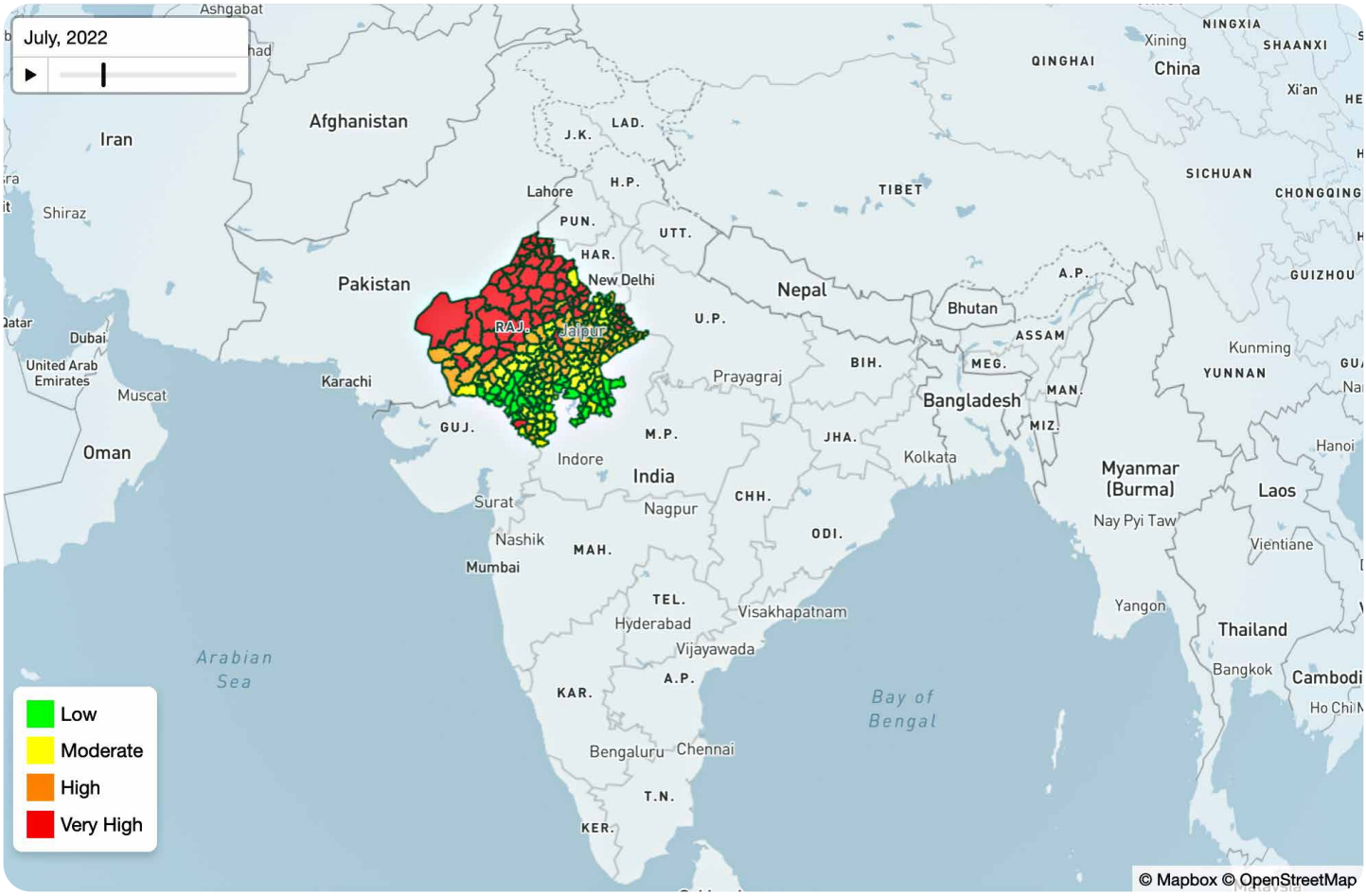
Source: Khushi Baby[121]

120. Microsoft. (n.d.). "How ASHABot empowers rural India's frontline health workers".

121. Ramjee, P. et al. (2025). "ASHABot: An LLM-Powered Chatbot to Support the Informational Needs of Community Health Workers".

On the back end, Khushi Baby applies geospatial predictive models to analyse longitudinal health data and identify high-risk populations, disease hotspots and climate-sensitive vulnerabilities. These outputs are visualised through live dashboards accessed by public health administrators, enabling real-time, data-driven planning and more precise allocation of resources. For example, Khushi Baby partnered with the Ministry of Health and Family Welfare in Rajasthan to prioritise screening for symptomatic and at-risk population groups for Tuberculosis (TB) and therefore increase positive case detection rates by nine to 10 times the previous TB screening cycle.[122]

Khushi Baby dashboard view



Source: Khushi Baby

The AI stack combines foundational LLMs and WhatsApp APIs with large-scale, longitudinal datasets covering more than 50 million individuals across 800 key public health indicators and 12 primary healthcare programmes. This infrastructure enables reliable insight generation while ensuring that AI outputs are embedded within existing health worker workflows and public sector systems. Each AI tool is designed with contextual relevance in mind, including local language processing and alignment with government protocols, to maximise usability and uptake in real-world environments.

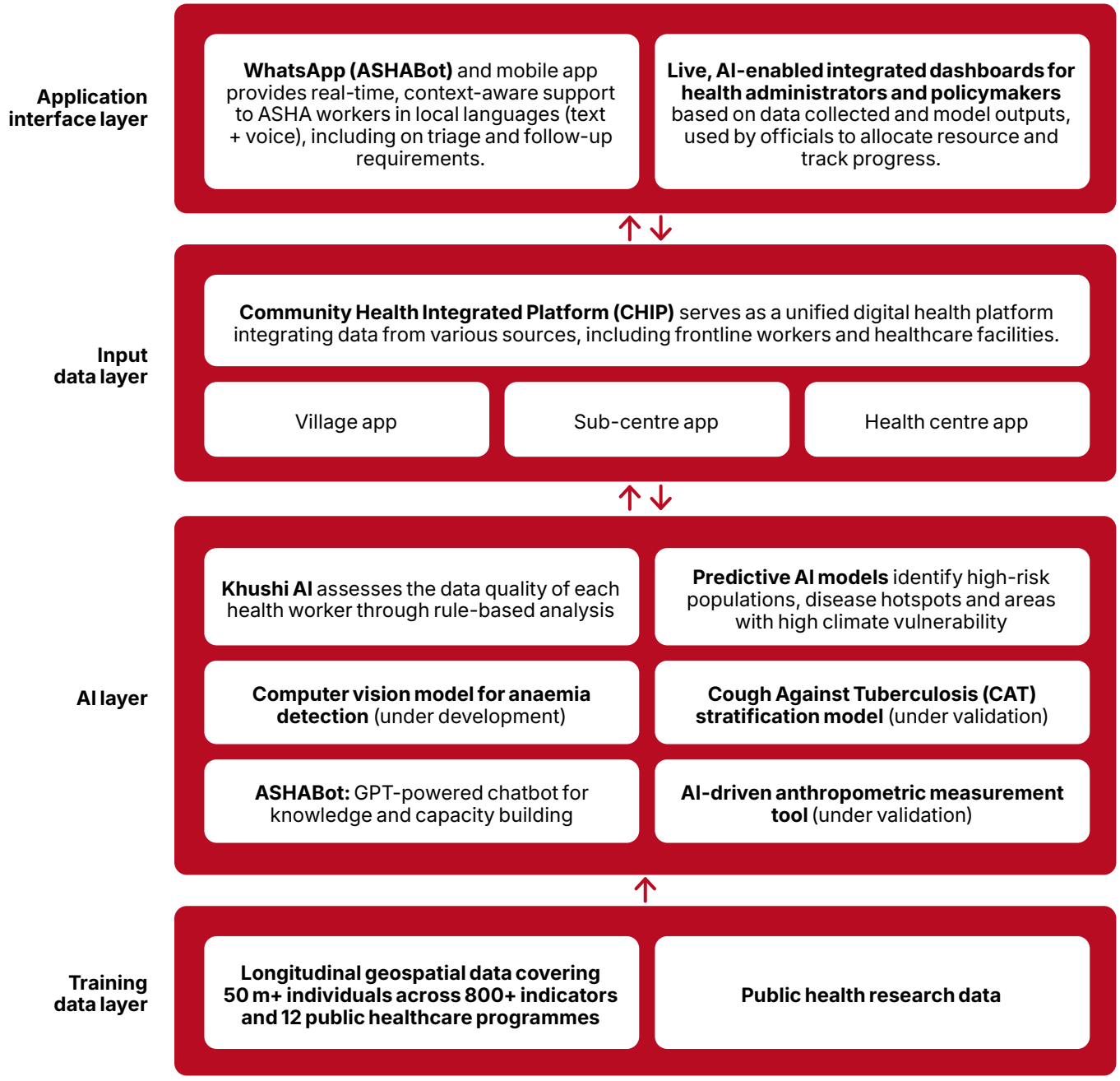
Khushi Baby is also in the process of validating advanced AI healthcare tools developed by Wadhwani AI, a non-profit AI research institute that develops AI/ML solutions to solve social challenges.[123] The first, the Cough Against Tuberculosis (CAT)[124,125] stratification model, uses the sound of a patient's cough alongside self-reported symptoms to rapidly screen

122. Khushi Baby, "Tuberculosis".
123. Wadhwani AI: https://www.wadhwaniai.org/
124. Wadhwani AI. (2025). "Using the Sound of a Cough to Fight a Global Epidemic".
125. WHO. (13 November 2025). "Tuberculosis".

for presumptive pulmonary TB, achieving a confidence rate of 96%. The second is an AI-driven anthropometric measurement tool, Shishu Maapan.[126] With this solution, a CHW can upload a brief smartphone video of a newborn and instantly receive accurate measurements of weight, length and head/chest circumference. This enables rapid i dentification of at-risk infants directly at the point of care.

Additionally, Khushi Baby is leading a large-scale study, enrolling more than 40,000 pregnant women to build in-house the first AI foundation model for anaemia detection in LMICs. Named MAHILA, it is a non-invasive anaemia detection tool that allows health workers to screen for moderate anaemia by taking photographs of the patient's lower eyelid and tongue using a low-end smartphone. By leveraging computer vision and field-ready technology, this approach aims to deliver cost-effective, non-invasive diagnostics in last-mile settings, increasing access to treatment at the community level and flagging high-risk cases early to reduce preventable maternal deaths.

Figure 26: Khushi Baby AI architecture and data flow



Source: GSMA (2025)

126. Wadhwani AI. (2025). "Ensures Every Child Gets a Healthier Start".

Technology profile	
Type of AI:	Predictive AI, GenAI
Type of technology used:	Predictive analytics, computer vision, speech-to-text (STT), NLP
Main users:	Community health workers, health facilities, health administrators and policymakers
Delivery channels:	Mobile app, WhatsApp, live web dashboards
Technology partners:	Microsoft Research India, Google, OpenAI and Amazon Web Services (AWS)

Business model

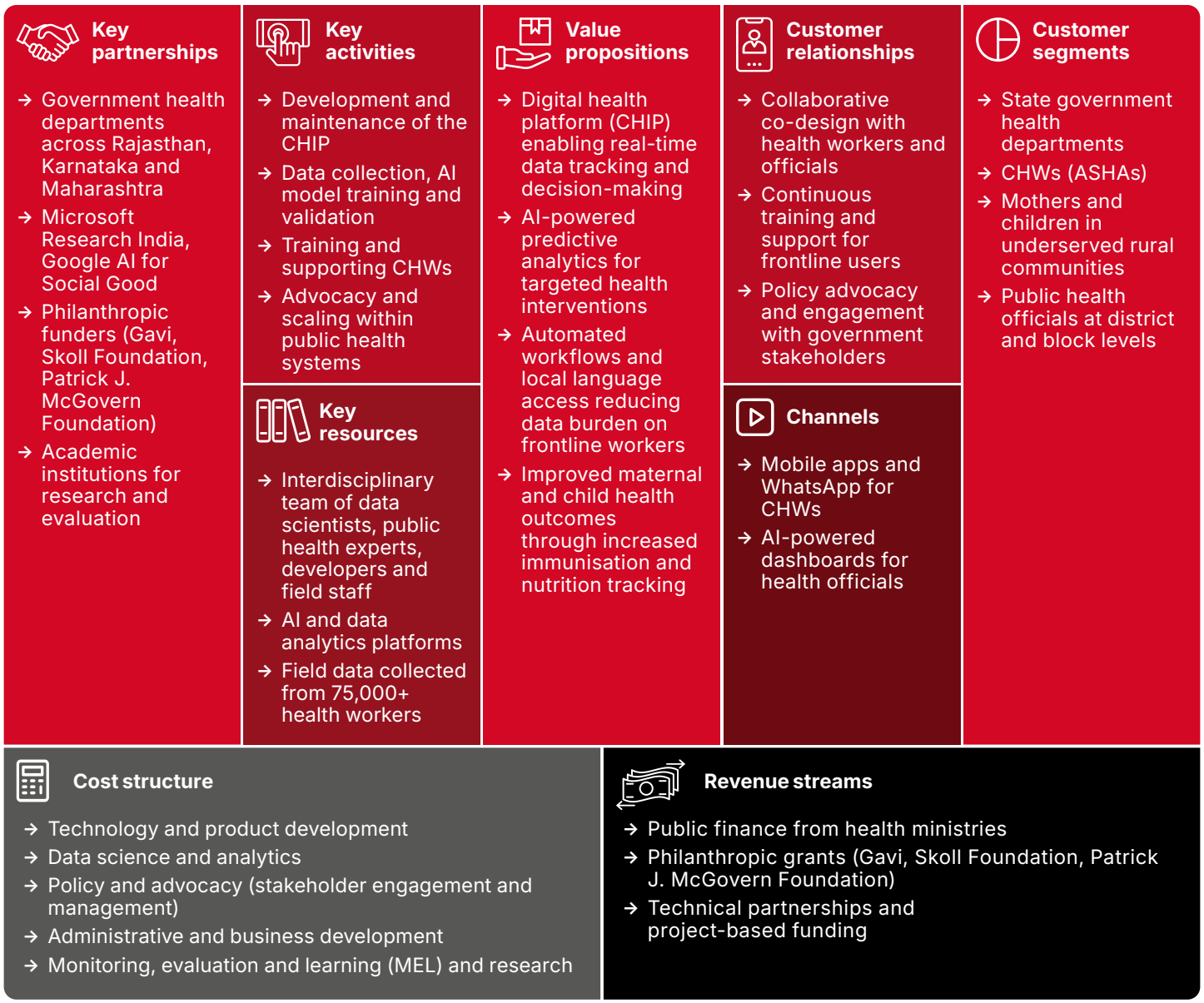
Khushi Baby operates on a business-to-government (B2G) model, partnering directly with state health departments to embed its digital solutions within public health systems at scale. The organisation draws support from a mix of philanthropic and multilateral funders, including Gavi,[127] the Patrick J. McGovern Foundation[128] and the Skoll Foundation;[129] Venture Philanthropy partners such as ACT Grants[130] and LGT Venture Philanthropy;[131] as well as growing private-sector contributions from partners like Infosys Foundation;[132] and substantial public financing, including $20 million from India's Ministry of Health.[133]

To ensure it remains sustainable over the long term, Khushi Baby prioritises the institutionalisation of its technologies, integrating them in official government workflows, budgets and strategic plans. Many of Khushi Baby's digital tools are now part of the Rajasthan State Digital Health Mission and are co-financed by central and district governments across Maharashtra.

Complementing its public-sector relationships, Khushi Baby collaborates with leading tech companies, including Microsoft Research India, Google, OpenAI and AWS to co-develop and maintain AI systems.

127. Gavi: https://www.gavi.org/
128. Patrick J. McGovern Foundation: https://www.mcgovern.org/
129. Skoll Foundation: https://skoll.org/
130. ACT: https://actgrants.in/
131. LGT Venture Philanthropy: https://www.lgtvp.com/en
132. Infosys Foundation: https://www.infosys.org/infosys-foundation.html
133. Khushi Baby: https://www.khushibaby.org/homepages/cases-html

Figure 27: Khushi Baby business model canvas



Source: GSMA (2025)

Impact and results

Khushi Baby's platform is embedded in large-scale public health deployments across India, supporting more than 75,000 health workers and reaching more than 45 million beneficiaries across more than 40,000 villages. Its tools enhance frontline service delivery through real-time triage, follow-up guidance and data collection, tailored to local languages and low-connectivity conditions.

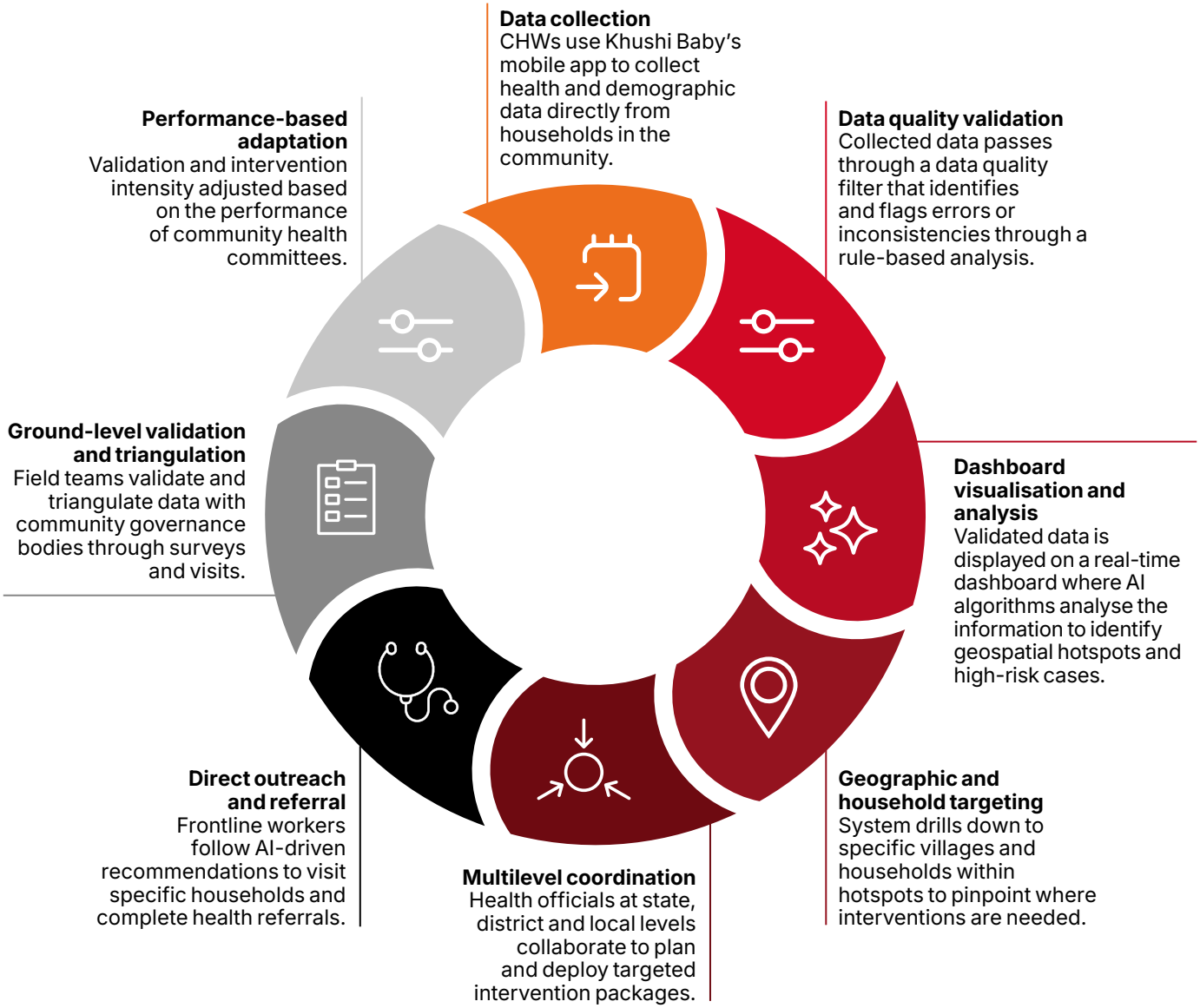
By integrating AI in routine workflows, Khushi Baby helps health systems detect disease risks early, monitor care delivery and improve follow-through, ultimately closing the gaps in India's public health system. To date, the platform has supported more than 12 million immunisations, screened 29 million people for non-communicable diseases (NCDs)[134] and flagged thousands of high-risk cases, including more than 5.9 million TB screenings and 37,000 suspected anaemia cases.[135]

The system also enables contextual risk tracking, identifying areas vulnerable to heatwaves, drought or poor air quality. This data-driven approach allows programmes to adapt in real time, improve health outcomes and guide the replication of effective interventions across regions.

134. Noncommunicable diseases (NCDs), also known as chronic diseases, tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behavioural factors. WHO. (25 September 2025). "Noncommunicable diseases".

135. Khushi Baby, "Our Impact".

Figure 28: Khushi Baby user journey



Source: GSMA (2025)

Challenges and future outlook

Expanding capabilities and geographies

Khushi Baby plans to strengthen its predictive modelling capabilities, particularly by developing foundation models for anaemia detection in pregnant women and early warning systems (EWS) that address climate-linked health risks for heat, air pollution and vector-borne diseases.

Khushi Baby is also expanding geographically to reach more frontline workers and districts across India, while continuing to advocate for the integration of digital and AI tools in public-sector budgets to ensure sustainability at scale. Khushi Baby aims to reach 100 million people by digitally equipping 100,000 CHWs and supporting more than 10% of India's health officials in decision-making by 2030.

Building and funding local AI models

Building local AI foundation models is crucial for developing scalable, reliable and contextually relevant solutions that address the unique health

challenges of diverse populations, particularly in LMICs like India, as large pre-trained models often lack training on datasets from communities where they are to be deployed and struggle to perform effectively in low-resource settings where CHWs operate.

However, developing these foundation models involves significant financial investment and commitment over years. It requires extensive data collection, computing resources, skilled R&D personnel, continuous learning and refinement cycles. Only a limited number of philanthropic donors are willing to support such long-term, high-risk, high-reward initiatives. This scarcity of sustained, predictable funding is a major obstacle for Khushi Baby to build AI models that truly fit local contexts.

Validation and expertise challenges

Building EWS for vector-borne diseases like malaria and dengue demands long-term validation, often five to 10 years to confirm predictive accuracy before widespread adoption in public health programmes. Securing rigorous validation and publication of predictive AI models is also challenging for Khushi Baby as a shortage of qualified AI and ML experts in the health and non-profit sectors makes credible peer review difficult.

Equity, scale and sustainability

Addressing health equity remains a pressing concern. Frontline health workers, including doctors, nurses and CHWs, often face inadequate compensation and resources. For instance, ASHAs are categorised as volunteers in India, lacking official worker status and the benefits that come with it.[136] This inequity creates tension around funding AI tools that assist these workers, highlighting an ongoing conflict between investing in innovation and meeting fundamental workforce needs.

Community grounding and co-design

Khushi Baby's success depends not only on the sophistication of its AI models but equally on its rigorous grounding in community realities. It has invested significant time and effort in gathering ground-truth data through community listening sessions and human-centred design (HCD). This approach allows Khushi Baby to deeply understand the cultural and regional nuances influencing healthcare decision-making. By co-designing solutions with frontline health workers and local communities, Khushi Baby aims to ensure its AI-driven interventions are contextually relevant, trusted and effective at addressing complex social and behavioural factors that standard data alone cannot reveal.

136. Padanna, A. (13 March 2025). "India's frontline health workers fight for better pay and recognition". *BBC*.

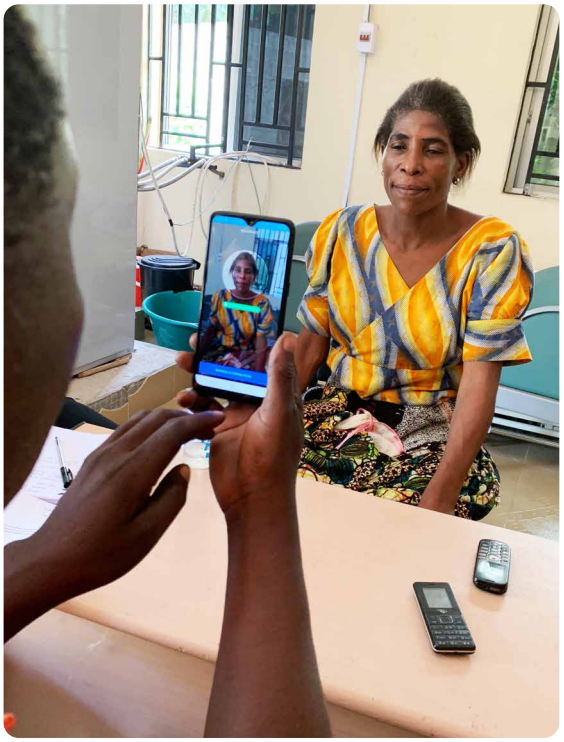
Case study: **Simprints**

Context

In LMICs, the delivery of essential health services and humanitarian assistance often fail to reach affected communities due to weak or non-existent identity verification systems. For instance, the World Bank's own assessments indicate that nearly a third of aid projects fall short of achieving their intended outcomes.[137] For services such as vaccination campaigns, maternal health initiatives or nutrition programmes, this lack of reliable verification translates directly into lower coverage, reduced accountability and weaker health outcomes.

Fragmented health infrastructure, combined with limited connectivity in rural areas and conflict zones, forces reliance on traditional identity systems, such as paper-based registries, basic ID cards or fingerprint scanners that frequently break down in last-mile contexts. These tools can be error-prone, difficult to scale and susceptible to damage, fraud or duplication. Moreover, the lack of interoperability across agencies, programmes and digital health systems makes it difficult to track service delivery or prevent duplication, exacerbating the challenges.

The SimprintsID facial recognition app on a smartphone.



Source: Simprints

About Simprints

Based in Cambridge, UK, Simprints is a non-profit tech enterprise that helps bridge the identity gap with affordable biometric identification tools tailored for low-resource and last-mile settings. Depending on the context, its solution combines facial recognition or robust fingerprint scanners with AI-powered matching algorithms to verify identities accurately and inclusively, even in areas with limited infrastructure or connectivity. By integrating with widely used digital health platforms like DHIS[138] and CommCare,[139] Simprints enables partners such as BRAC[140] and Gavi[141] to deliver targeted health services, such as maternal care and vaccination campaigns, ensuring the right people are reached at the right time.

Organisation profile

Year founded: 2015

Business type: Non-profit, B2B

Funding: Grant funding

Team size: About 50 employees

Geographies: Africa and Asia

137. Kenny, C. (23 January 2017). (2017). "How Much Aid is Really Lost to Corruption?" *Center for Global Development Blog.*

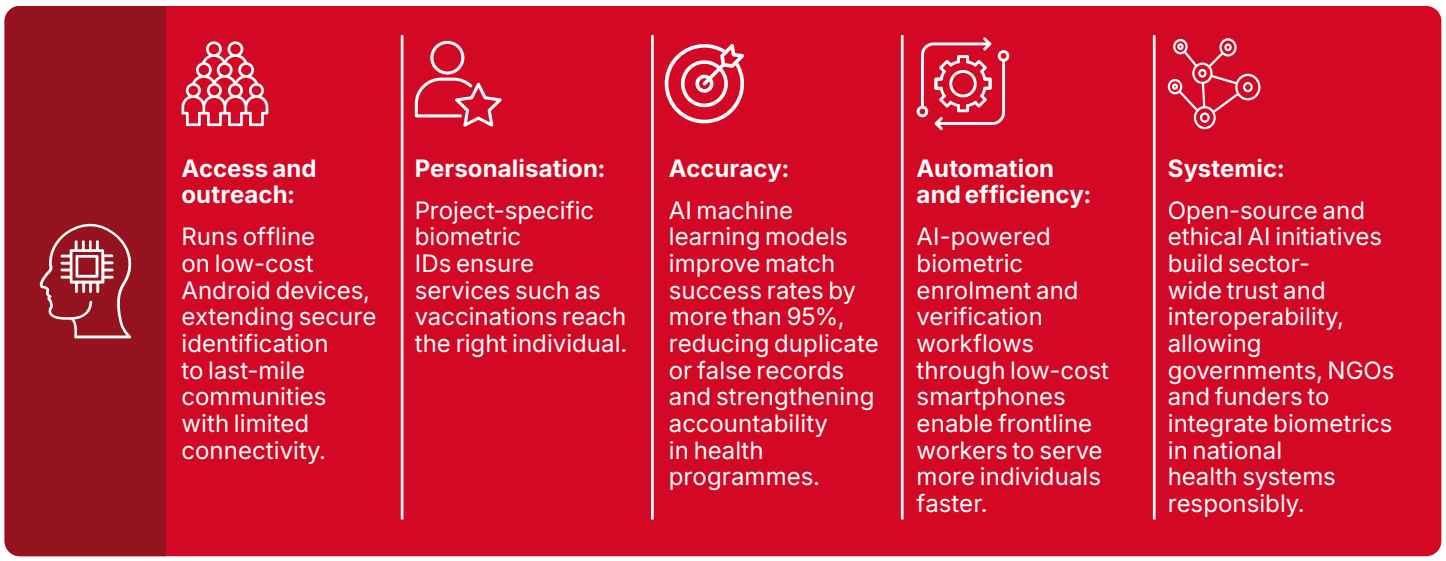
138. DHIS2 is an open-source software platform developed and implemented by the HISP network, a global collaboration between the HISP Centre at the University of Oslo and local HISP groups in Africa, Asia, the Middle East and the Americas. HISP's work with local stakeholders over more than 30 years has supported the adoption of DHIS2 as a locally owned information system in more than 80 countries. DHIS2.

139. CommCare primarily refers to an open-source mobile platform for data collection and service delivery, developed by Dimagi, which enables frontline workers to use customised apps to collect data and provide services in resource-limited areas, even offline. Dimagi.

140. BRAC International

141. Gavi

Figure 29: The value AI adds to Simprints



Source: GSMA (2025)

AI solution and architecture

Simprints has evolved significantly in its use of technology over the past decade. Early deployments relied on custom design and manufacture-to-order fingerprint hardware scanners, using rule-based pattern recognition algorithms. While innovative at the time, the solution required custom hardware that was expensive, difficult to distribute and maintain and not always accurate. In 2021, Simprints conducted a trial to explore ways to reduce its dependence on custom hardware and make its solutions more affordable. Instead of fingerprint recognition, it tested facial recognition powered by ML algorithms from a commercial provider. The results showed that facial recognition was more accurate in a significant number of cases. Leveraging insights from the trial, advances in ML and more affordable smartphones in LMICs, Simprints is now shifting from legacy algorithms to systems based entirely on machine learning.

Simprints' ML approach to biometrics is replacing earlier rule-based fingerprint matching systems with AI models that learn directly from large datasets of biometric images. Rather than relying on pre-defined minutiae points, the models automatically determine which features are most useful for distinguishing individuals, leading to significantly higher matching accuracy. The system operates in two main modes: verification (1:1), where it confirms whether the person in front of a health worker matches a stored identity, and identification (1:N), where it finds the person within a larger database. Accuracy is measured using industry standards such as the False Non-Match Rate (FNMR)[142] at a set False Match Rate (FMR)[143] for verification, and True Positive Identification Rate (TPIR)[144] for identification tasks. Simprints benchmarks its models to achieve, for example, TPIR-5 of 95% or above, meaning the correct match is returned within the top-five candidates in at least 95% of cases. These models are lightweight enough to run offline on basic smartphones, ensuring they are practical in last-mile, low-connectivity environments.

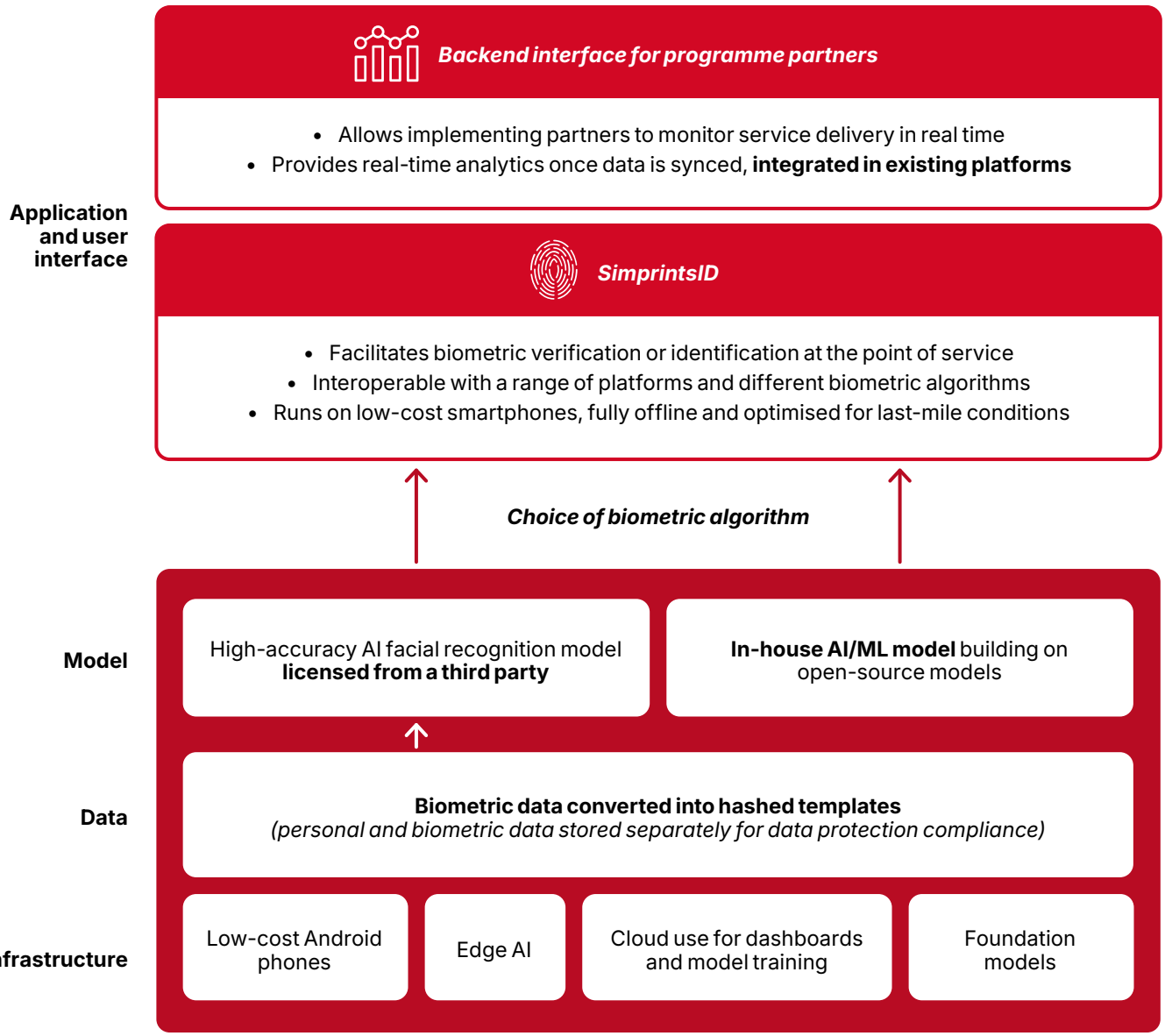
Simprints employs edge AI by running its facial recognition models on low-cost smartphones used by frontline workers. All biometric processing, including face detection, feature extraction and matching, occurs locally on the device, without reliance on cloud connectivity. The front-end application, SimprintsID, operates fully offline and supports both biometric identification and verification at the point of service. Designed for flexibility, the system is interoperable with multiple biometric algorithms and can integrate seamlessly with existing digital health platforms, enabling reliable identity verification in resource-constrained and offline environments.

142. False Non-Match Rate is the error rate that occurs in biometric identity verification tools when two identities belonging to the same person are flagged as a non-match.
143. False Match Rate is the estimated error of a biometric authentication system in which it incorrectly matches two entirely different individuals and identifies them as the same person.
144. The true positive identification rate is the proportion of positive instances that are correctly classified by the model.

On the back end, programme partners such as Mercy Corps and ministries of health[145] can monitor service delivery through a real-time analytics dashboard that syncs with their existing systems. At the core of the architecture is a modular design that incorporates a choice of biometric algorithms, including proprietary models trained on open-source frameworks and licensed facial recognition software from third-party providers. All biometric data is converted into hashed templates for security with personal identifiers stored separately, in compliance with GDPR and the UK Data Protection Act.

The upgraded AI-based solution has significantly improved matching accuracy compared to earlier methods, as ML models identify features in biometric data without pre-defining parameters, adapting to real-world variability.

Figure 30: Simprints AI architecture and data flow



Source: GSMA

145. Simprints

Technology profile	
Type of AI:	Predictive AI
Type of technology used:	ML, edge AI
Main users:	Health extension workers, programme partners
Delivery channels:	Mobile app, web platform (real-time data visualisation dashboards)

Business model

Simprints operates as a non-profit organisation with a hybrid funding and partnership model. In its early years, the organisation relied on innovation grants from institutions such as USAID and the Gates Foundation to validate its technology and pilot early deployments. Over time, the model evolved to project-based revenue, with most of the funding now coming directly from large donors and global health funders, including Gavi and the Children's Investment Fund Foundation (CIFF). These funders value Simprints' ability to verify that millions of dollars in programme investments are translating into services delivered to real, unique individuals.

In practice, contracts are typically signed between Simprints and the funder, with implementation carried out in collaboration with ministries of health, NGOs or local organisations. While NGOs were initially seen as primary partners, their incentive to maintain high reported impact numbers sometimes clashed with Simprints' verification role. As a result, Simprints is increasingly exploring direct government partnerships as a path to scale and sustainability, aiming to embed its technology in national health and social protection systems. This evolution reflects a broader move to longer-term system integration and localisation of services.

Complementary funding still comes from CSR initiatives, prizes and smaller innovation grants, but these represent a smaller share of revenue.

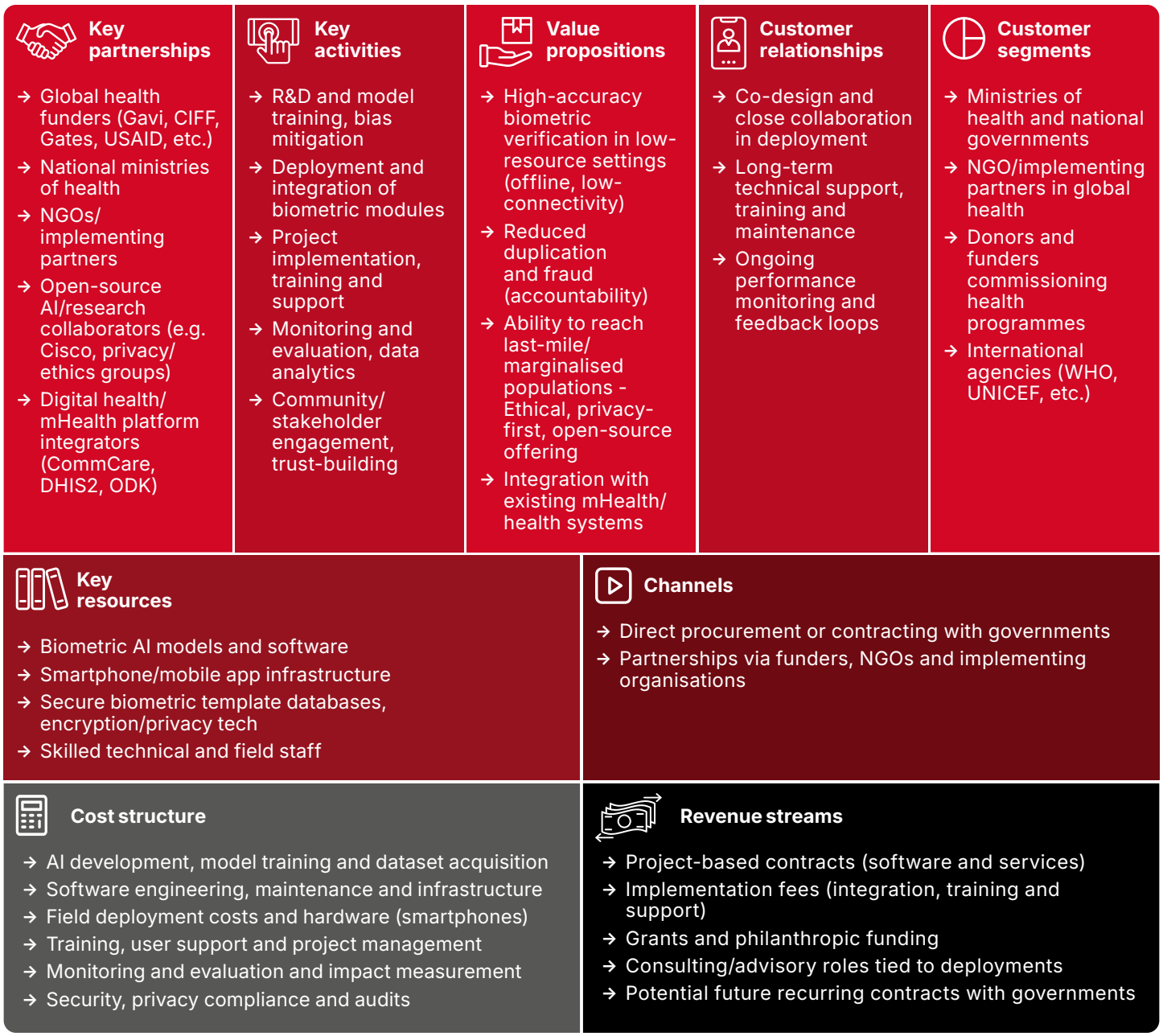
Impact and results

Simprints is having an impact in several key areas, including more accurate identity verification and more efficient and equitable service delivery. Through its AI-powered tools, individuals can be reliably identified, helping to reduce both exclusion and duplication in public health programmes. By automating traditionally manual verification processes, Simprints lightens the operational load on frontline workers and enables real-time monitoring by programme teams.

On-device AI supports offline functionality, allowing services to reach underserved populations even in low-connectivity or last-mile settings. With AI-powered facial recognition technology for biometric verification, Simprints reported verification success rates of more than 95%, even in last-mile settings with poor connectivity, variable lighting and basic mobile devices. In comparison with earlier pattern recognition-based fingerprint biometric verification systems, facial recognition showed lower enrolment failure rates and faster matching times, leading to improved workflows for frontline health workers and increased completion rates for interventions like vaccination schedules. Since 2015, Simprints has enrolled 3.5 million people, supported more than 50 projects in 17 countries and worked with more than 100 global partners and 5,000 frontline users. Its biometric tools have helped identify more than 500,000 duplicate records and contributed to measurable improvements in service delivery outcomes, including a 56% increase in linking women to HIV care in Malawi and a 39% rise in maternal health coverage in Bangladesh.[146]

146. Simprints. (2024). *Impact Review 2024*.

Figure 31: Simprints business model canvas

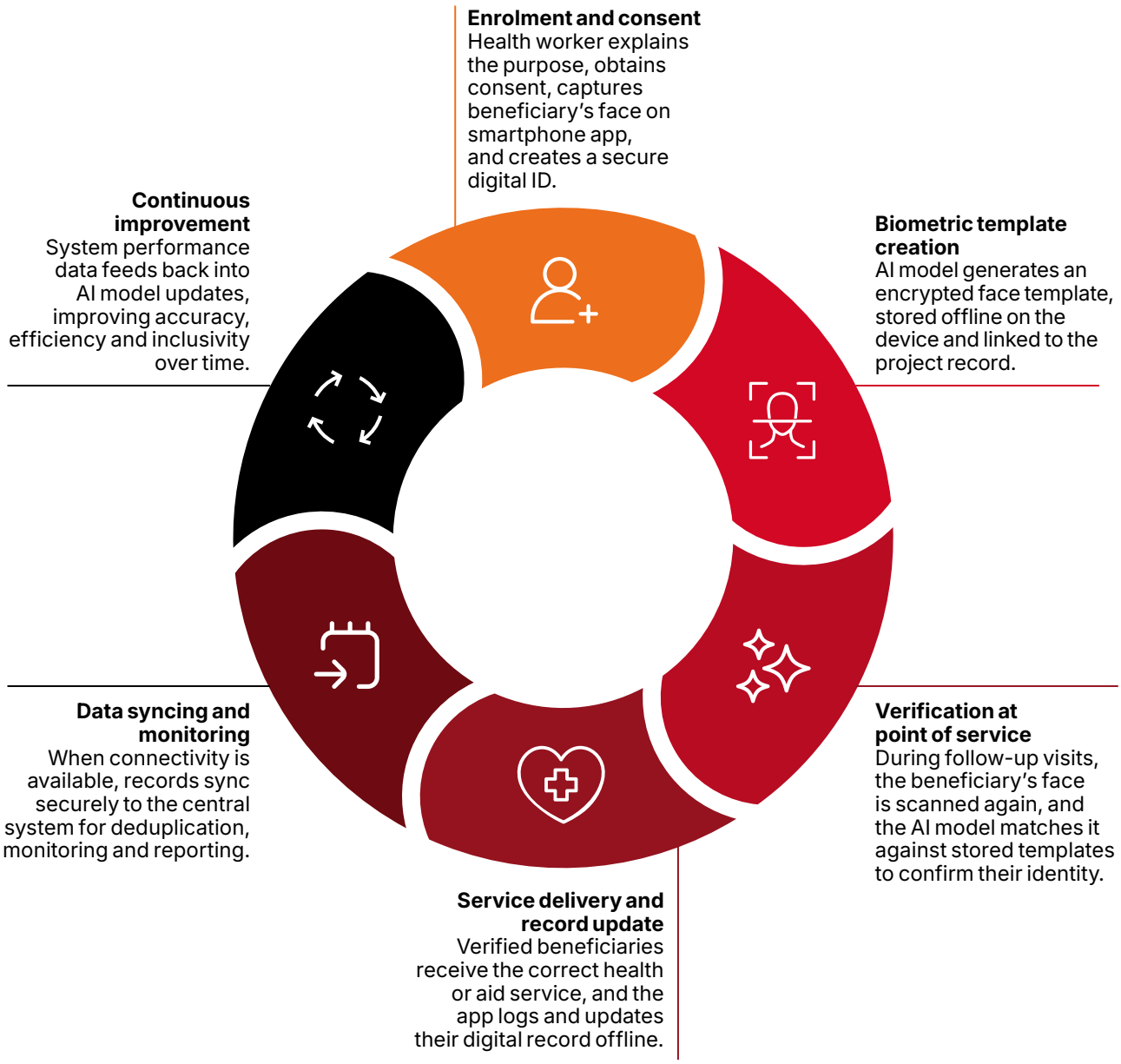


Source: GSMA (2025)

Simprints is also accelerating its commitment to open-source, ethical and inclusive AI in partnership with Cisco's Global Impact Grant programme.[147] As part of this initiative, Simprints is making key parts of its face recognition technology publicly available, building training datasets that are more representative across skin tones, genders and demographics, and exploring the use of synthetic facial images to boost diversity without compromising privacy. By making its technology open source, Simprints is positioning itself as a digital public good and enabling wider collaboration among developers, researchers and governments. The aim is to reduce bias, improve fairness in biometric matching and amplify impact, with aspirations to empower partners to reach 20 million people through health and humanitarian assistance programmes.

147. Simprints. (9 April 2025). "Cisco support Simprints to advance ethical, inclusive AI for face recognition biometrics".

Figure 32: Simprints user journey



Source: GSMA (2025)

Challenges and future outlook

Simprints is expanding both technically and operationally by embedding biometric verification in national health systems and aligning its solutions with emerging digital ID frameworks. For instance, in partnership with the Ghana Health Service and with support from Gavi, Simprints is integrating both contact and contactless biometric technologies in national health programmes to strengthen patient tracking in the fight against malaria and to improve maternal and child health outcomes through more accurate, data-driven service delivery.[148]

A key challenge in this transition is scaling beyond donor-funded projects into sustainable government procurement, which requires long-term investment and integration in national digital health strategies. While health remains its core focus, there is potential for Simprints' technology to be applied across adjacent domains such as nutrition, education and cash transfers.

Despite progress, Simprints continues to face challenges around perception and stakeholder alignment. Biometric verification, while strengthening accountability, can also expose inflated impact numbers in existing programmes,

148. Simprints. (25 April 2025). "Strengthening malaria vaccination in Ghana with the power of biometrics".

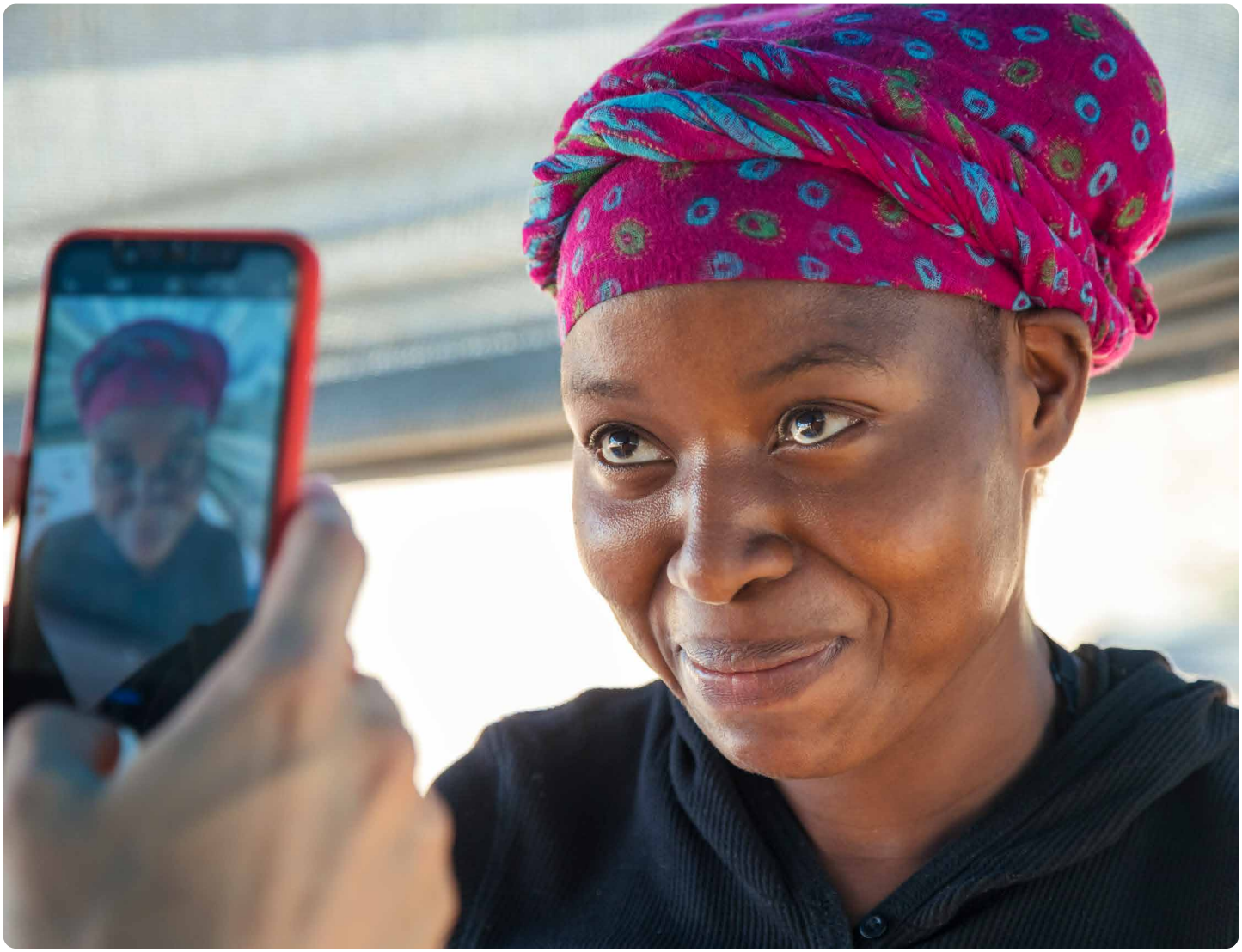
at times creating tensions with implementing partners and NGOs whose reporting incentives are affected. Managing these dynamics requires building trust, change management and careful engagement with partners.

On the technical front, Simprints is investing in research to address the complexity of child biometrics, a problem where conventional algorithms struggle due to children's changing physical features. The organisation is also exploring the use of synthetic data[149] to train and test AI models in a way that preserves privacy, reducing risks while improving performance for diverse populations.

Opportunities may lie in forging new partnerships that extend Simprints' impact and reduce barriers to scale. Collaborations with MNOs could support outreach through zero-rated digital health platforms, improve planning with anonymised mobility data and strengthen continuity of care through automated reminders.

Beyond health, Simprints' model has potential applications in education, agriculture and social protection, but the immediate priority is to consolidate scale and sustainability in health systems.

As it transitions from reliance on donor-funded projects to government-backed contracts and long-term programme revenue streams, Simprints' ability to adapt its model, strengthen cost-effectiveness and become embedded in national systems will be critical to sustaining impact at scale.



149. Synthetic data is artificial data designed to mimic real-world data, generated through statistical methods or by using AI techniques like deep learning and GenAI. Despite being artificially generated, synthetic data retains the underlying statistical properties of the original data it is based on. As such, synthetic datasets can supplement or even replace real datasets. IBM. Synthetic data.

SPOTLIGHT 3: GLIFIC SIMPLIFIES AI-POWERED COMMUNICATION FOR NON-PROFITS

Glific[150] enables social impact organisations to interact with their communities through a customised WhatsApp chatbot, making two-way communication timely, efficient and cost-effective at scale. Its open-source, cloud-based SaaS platform enables non-profits to build chatbots using simple drag-and-drop functions, eliminating the need for advanced technical expertise. Organisations can upload documents or spreadsheets that the chatbot draws information from, and the system integrates with APIs like file search and Google Sheets to customise conversation flows. At the back end, the chatbot is powered by an LLM (currently Open AI's GPT-4), to generate responses to users' questions.

Glific provides organisations with some initial training and on-going support as needed, but aims to strengthen their capacity to ensure its chatbot solutions are sustainable over the long term. Glific also provides reporting and analytics features that help social impact organisations make more informed decisions based on the data generated by the chatbot.

Glific's solutions have been adopted by more than 110 non-profits, most of which are based in India. The service is now expanding into other Asian and African countries. Most of its chatbot deployments have been in the education sector, particularly by organisations working with public schools, and Glific has also supported initiatives in health, agriculture, employment, civic awareness and more.

POSSIBILITIES WITH AI ON GLIFIC

Source: Glific

150. Glific

Case study: **Kibo by Trestle Labs**

Context

Accessing printed, handwritten or digital content remains a significant barrier for individuals with visual impairments, learning difficulties and low language literacy. Individuals with visual impairment also miss out on content not offered in Braille or audio formats. Braille is often insufficient for those who lose their sight later in life, and audio textbooks can take weeks to produce, limiting access to education. Traditional assistive technologies and screen readers often lack support for local languages and struggle to process domain-specific handwritten or scanned documents, leaving vast amounts of material inaccessible.

The conversion of such content into accessible, searchable or audio formats is often time-consuming and expensive, perpetuating educational and employment inequalities for affected individuals. These limitations hinder equitable access to information, opportunities and participation.

About Trestle Labs

Founded in 2017, Trestle Labs is an assistive technology company based in Bengaluru, India, addressing barriers related to disability, language and literacy. It developed Kibo (Knowledge in a Box), a suite of AI-enabled tools to enable users to digitalise and contextually translate printed and handwritten content into searchable and editable formats, listen to the content and create downloadable audio narrations. The technology supports 60 global languages (including 15 Indian languages) with a focus on underserved African and Asian languages. Kibo is available as mobile and desktop applications for individuals and as hardware plus software kits for educational institutions.[151]

Organisation profile

Year founded: 2017

Business type: For profit

Stage: Early growth

Funding: Series A

Team size: 20+

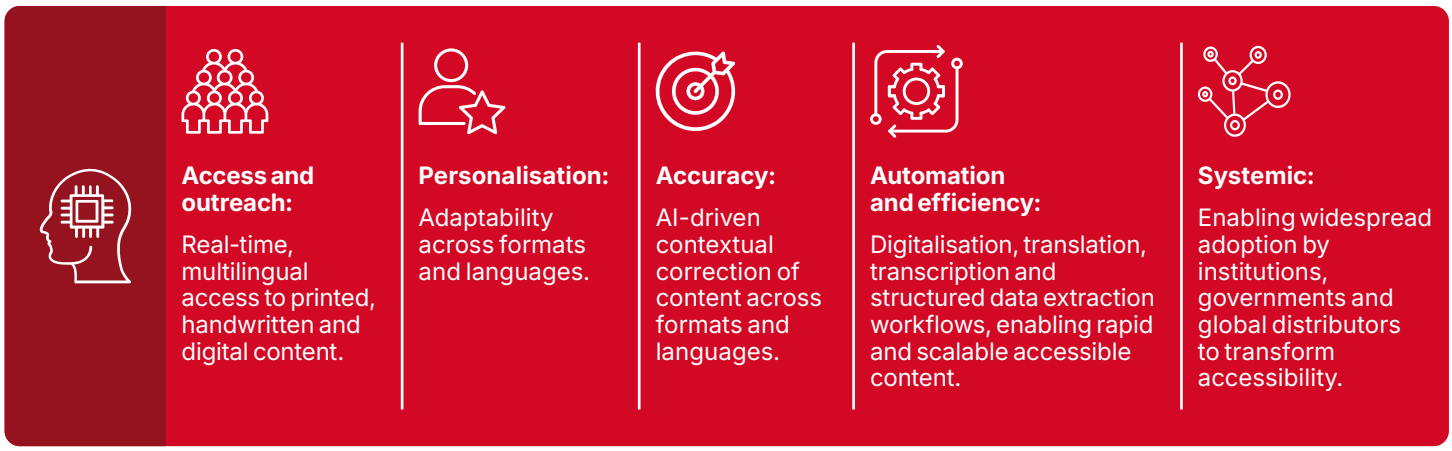
Geographies: India, Nepal, Bangladesh, Southern Africa

Kibo Kits for institutions

Source: Trestle Labs

151. Trestle Labs

Figure 33: The value AI adds to Kibo



Source: GSMA (2025)

AI solution and architecture

For academic institutions and individual users

Kibo's modular AI architecture is designed to process multiple input formats such as printed or handwritten documents (physical books, notes, prescriptions), as well as multimedia inputs including audio and video.

Documents are scanned via the Kibo XS device (a portable, talking, table lamp-shaped device) or captured using a phone camera through the Kibo mobile app, while digitalised content, audio and video inputs can also be ingested for processing. Optical character recognition (OCR)[152] combined with proprietary AI models extracts textual content with high accuracy from both printed and handwritten texts.

A proprietary AI engine assesses document type, language, orientation and context to select the most suitable pre-trained or fine-tuned models for processing. By fine-tuning pre-existing open-source models for sectors like education, healthcare, insurance and law, Trestle Labs replicates human contextual understanding in Kibo, enhancing accuracy and relevance.

Experts are involved in data labelling and model fine-tuning to ensure domain-specific precision. The company establishes self-training loops to continuously improve these models after deployment. This approach allows for deployment both on-premises and on the cloud, balancing large and lightweight models depending on use case requirements.

This dynamic model selection ensures accuracy across languages, contexts and handwriting styles. The document processing layer uses a combination of open-source OCR engines, multilingual NLP and custom domain-specific models to extract and interpret content.

Semantic correction modules help improve accuracy, especially for handwritten or poorly scanned texts, using AI to make corrections automatically by replacing words based on context. Processed content is routed through a customisation layer that adapts outputs to user profiles. For example, text can be routed through multilingual translation modules to produce contextually accurate digital copies or audio output.

Individuals with visual impairments, learning difficulties and low language literacy benefit from instant audio playback, professionals receive translated documents tailored to their needs, corporate clients gain structured datasets in Excel format and screen reader-compatible files are generated automatically. This flexible approach ensures accessible output for varied user groups and integrates seamlessly across institutional, professional and accessibility use cases.

For corporate users

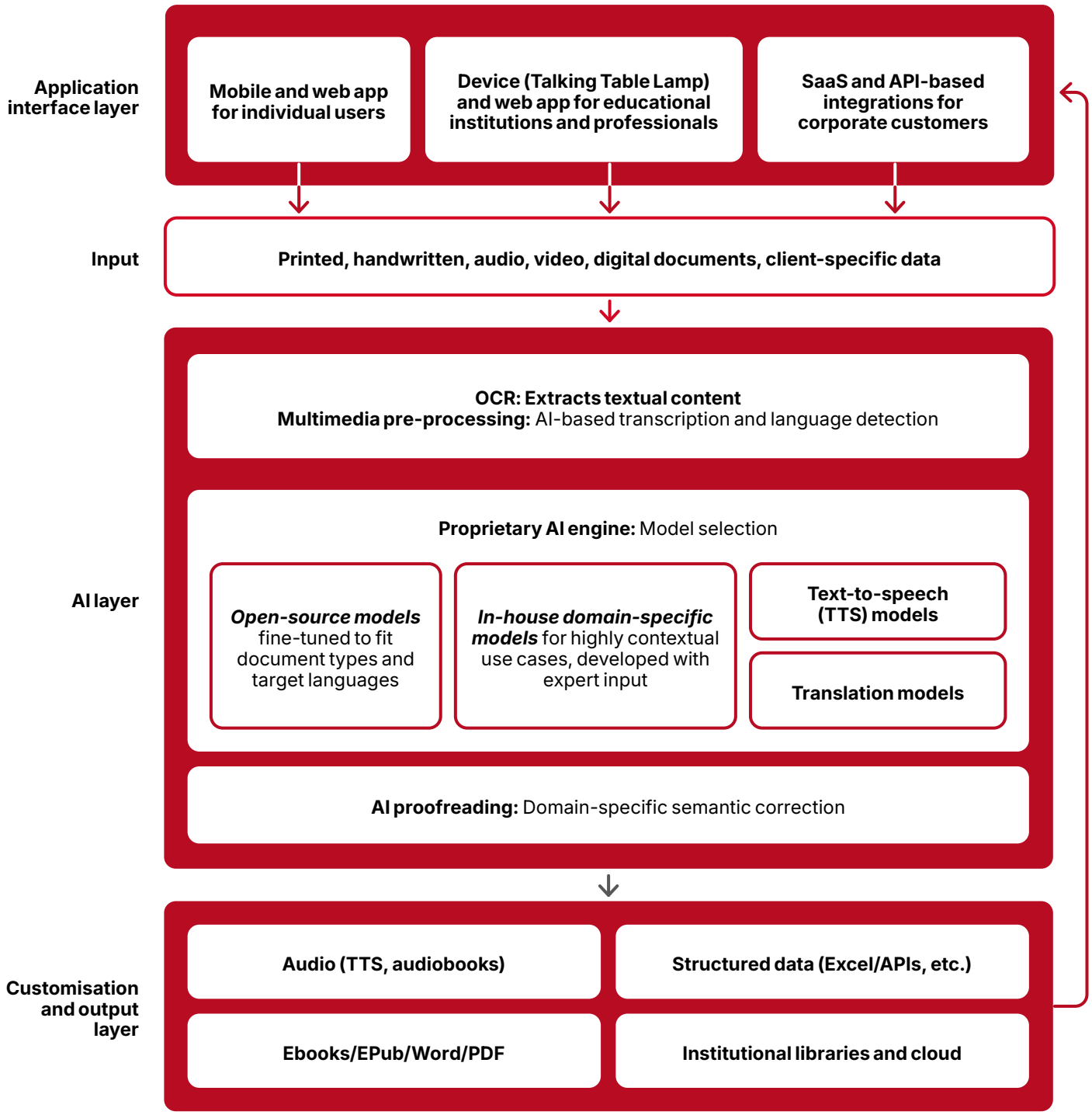
Trestle Labs offers solutions that include Cognition-as-a-Service (CaaS)[153] and customised, industry-specific models.

152. Optical character recognition (OCR) is a technology that uses automated data extraction to quickly convert images of text into a machine-readable format.

153. Cognition as a Service (CaaS) is the delivery of AI-based cognitive capabilities via the cloud, enabling applications to perceive, understand and act intelligently through accessible APIs and managed AI services.

The CaaS offering enables companies to transform large volumes of unstructured, multilingual and multimodal data, including printed, handwritten, audio and video content into structured, actionable insights through Trestle Lab's proprietary AI engine. Leveraging pre-trained, domain-specific models across sectors such as insurance, banking, healthcare, law and education, Trestle Lab's intelligent document processing engine performs context-aware data extraction, translation, transcription and digitalisation. Companies can integrate these capabilities through easy-to-deploy APIs or opt for custom cognitive process automation tailored to their workflows.

Figure 34: Kibo AI architecture and data flow



Source: GSMA (2025)

Technology profile	
Type of AI:	Predictive AI, GenAI
Type of technology used:	Fine-tuned LLMs (by OpenAI), OCR, NLP, TTS
Main users:	Individuals with visual impairment, professionals, educational institutions and companies
Delivery channels:	Mobile app, web app, Kibo XS device and SaaS

Business model

Trestle Labs operates primarily as a B2B company, with approximately 90% of revenue derived from education. It sells to schools, universities, NGOs, government projects and distributors across 25 countries. These organisations typically purchase annual or renewable licences for modular accessibility solutions, both the Kibo XS device and software (e.g. content digitalisation, document accessibility). Average enterprise contracts are valued at around $30,000 per year.

A complementary B2C freemium[154] model enables individuals with visual impairments, learning difficulties and low language literacy to access mobile and desktop apps through affordable subscriptions, typically priced between $22 and $45 per year. This approach expands access to underserved users while reinforcing Kibo's user base and feedback loop.

Its appearance on Shark Tank India[155] in early 2024 not only enabled Trestle Labs to secure an investment of more than £50,000 against 6% equity, but also gave it the credibility and visibility to transition from primarily serving educational and accessibility markets to corporate and enterprise partnerships. It now offers CaaS solutions for enterprises in the insurance, healthcare and banking sectors.

Content partnerships

Trestle Labs has forged content partnerships with Sugamya Pustakalaya[156] (India's largest accessible online library, developed by the Department of Empowerment of Persons with Disabilities and DAISY Forum of India) and Bookshare[157] (a global accessible e-book library serving people with print disabilities). Through these partnerships, Kibo users gain access to more than 1 million books in accessible formats (such as audio, ePub and DAISY), from educational to professional and leisure reading materials. These partnerships significantly enhance Kibo's content ecosystem, enabling inclusive learning and reading experiences for people with visual and reading impairments.

Trestle Labs is bootstrapped and profitable, with lean operations and a tripling of revenue over the past two years. Its flexible licensing and localisation model supports adoption across diverse markets, including low-resource and multilingual contexts.

154. The freemium model offers basic features of a product or service for free while charging for advanced or premium features.

155. Shark Tank India is an Indian business reality television show based on the international Shark Tank/Dragon's Den format. Entrepreneurs pitch their business ideas to a panel of wealthy investors (the "Sharks"), seeking investment (money) in exchange for equity (a stake in the company). The show gives startups visibility, mentorship and potential funding.

156. Sugamya Pustakalaya

157. Bookshare

Figure 35: Trestle Labs business model canvas

Key partnerships

- **Content partners:** Sugamya Pustakalaya and Bookshare
- **Manufacturing partners:** Local vendors handling production of Kibo XS device
- **Distribution partners:** Assistive technology distributors across India, the US, UK, Middle East, Africa and Asia
- **Technology partners:** Google Firebase for running Kibo AI algorithms
- Local government programmes
- Schools, colleges and universities
- VOSAP (Voice of Specially Abled People)

Key activities

- AI product development and maintenance
- Direct sales and pilots with schools, universities, governments and companies
- Kibo XS hardware distribution
- Accessibility training and support
- Fundraising and ecosystem development

Value propositions

- All-in-one accessibility: Listen, Translate, Digitalise, Audiotise
- Supports 60+ languages and 100+ translation languages
- Affordable vs. traditional global assistive technology tools
- Enhances inclusion in education and work
- Wide access: 10 million+ books from repositories
- Process automation and digitalisation for corporate customers

Customer relationships

- Hands-on onboarding and training with individuals and businesses
- Cloud-based support (Kibo Cloud)- Educational institution partnerships
- Community engagement via local governments, NGOs and accessibility forums

Customer segments

- Educational institutions (schools, universities, libraries)
- Learners with visual impairment (students, professionals)
- NGOs and accessibility organisations
- Assistive technology distributors and resellers
- Corporate B2B customers

Key resources

- Proprietary AI technology stack
- Content repositories (Sugamya Pustakalaya, Bookshare)
- Manufacturing and logistics ecosystem
- Partnerships with universities, governments, Vosap
- Recognitions and awards (MIT Solve, DBS Foundation, etc.)

Channels

- Kibo mobile and web app
- Kibo XS device
- Direct API integrations (for corporate customers)

Cost structure

- R&D, AI model and app development/maintenance
- Manufacturing and supply chain
- Distribution, sales and training
- Institutional partnership management
- Compliance, certifications and outreach
- Marketing and outreach
- Strategic partnerships and licensing fees

Revenue streams

- B2B institutional contracts (universities, schools)- Device sales (Kibo XS)
- SaaS subscriptions (Kibo Desk, Kibo Mobile)
- Direct sales to corporate B2B customers
- Grants, awards and government programmes

Source: GSMA (2025)

Kibo XS Kit

Source: Trestle Labs

Impact and results

Trestle Labs' end-to-end AI pipeline has significantly expanded access to accessible content for users with visually impairment, while also improving efficiency for institutions and corporate clients. By automating the conversion of printed, handwritten and digital materials into audio and other usable formats in more than 60 languages, the solution dramatically reduces the time, cost and manual effort traditionally required to generate accessible content.

The use of AI enhances access and reach, particularly for underserved language groups, while improving accuracy through intelligent error correction and formatting. Its automation capabilities enable institutions to scale content digitalisation and reduce turnaround times from weeks to minutes.

Since its launch in July 2019, Trestle Labs has reached more than 200,000 users across nine countries and helped more than 700 institutions become more inclusive. Accessibility has also been supported through partnerships, most notably with VOSAP (Voice of Specially Abled People), an NGO that enables up to 90% subsidies for individuals with visual impairment in India to access Trestle Labs' tools, making assistive technology more affordable and equitable.[158]

Trestle Labs reached

200K

users in 9 countries and empowered

700+

INSTITUTIONS

to become more inclusive

158. VOSAP. (14 April 2023). "VOSAP Changing Lives with Kibo XS Device Subsidy Scheme".

Figure 36: **Kibo user journey**

User onboarding/ initial engagement
User acquires mobile app, web app or device kit

B2B customer integrates via API

Account set-up and familiarisation
Profile set-up and training

Document input
User places document under Kibo XS device, takes a photo with the Kibo mobile app and uploads a file or connects through APIs

Document scanning and processing
OCR, handwriting recognition and language detection

Contextual correction and translation
AI engine selects the correct model, digitalises content in real time and translates as per user preference

Editable, searchable content generation
Digitalised and audiotised content generated and delivered via mobile and web app, Kibo XS device or APIs

Source: GSMA (2025)

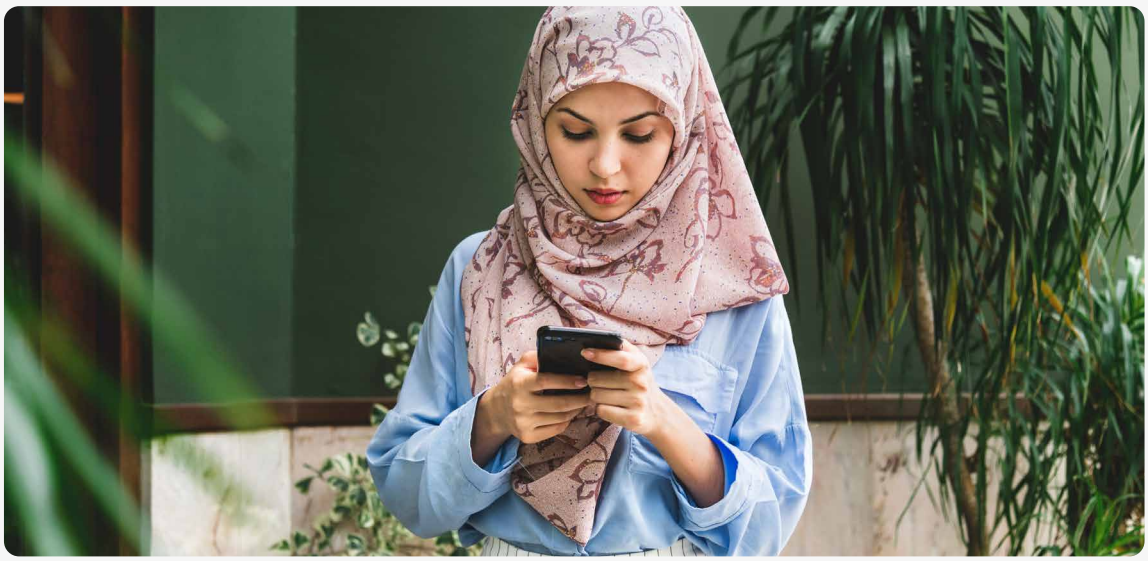
Challenges and future outlook

Developing and training AI models in-house, maintaining an efficient hardware supply chain, as well as securing market access and driving business development have been costly investments for the company and challenging in terms of growth. For domain-specific applications, Trestle Labs collaborates with clients and provides training to ensure data is delivered in correct formats, while also hiring specialists for data labelling and model fine-tuning. These resource-intensive processes may impact profit margins. Additionally, dependable internet connectivity at deployment locations is critical for serving all customer segments effectively.

Trestle Labs plans to scale its educational applications to more underserved languages across India, Asia and Africa through partnerships with government agencies, distributors, philanthropic organisations and funders. It is also expanding its AI-powered document processing services to new enterprise sectors, offering a competitive solution for intelligent document automation.

By 2029, the company aims to reach 10,000 B2B institutional users and 1 million individual users. Sustainable growth will be driven by continued investment in domain-specific AI and local language capabilities, positioning Trestle Labs as both an assistive technology provider and enterprise-grade digitalisation and automation AI platform.

SPOTLIGHT 4: UPLIFT AI BUILDS AI VOICE MODELS FOR PAKISTAN'S REGIONAL LANGUAGES



Voice is an increasingly popular way to interact with technology and vital for users with low literacy. Yet, voice models are inadequate or inaccessible in most of the world's languages. Pakistan-based Uplift AI is addressing this gap by building high-quality, AI-enabled voice models for regional languages. It aims to enable greater access to digital services, allowing people to interact by speaking in their native tongue. Uplift sees its voice models being applied across a range of use cases, from health information and agriculture to banking and e-commerce. Already, Khan Academy, the online learning platform, has used Uplift's model to dub hundreds of educational videos into Urdu.

To build its voice data library, Uplift developed a tool through which people can share their voice data, such as WhatsApp audio messages, with consent and compensation, at scale. For speech understanding and generation, Uplift uses commercial foundation models like OpenAI and Gemini, fine-tuned with its curated local datasets. Its Urdu, Sindhi and Balochi speech generation models, Orator, speaks with human-like realism, and performs better in user preference evaluations than any commercial text-to-speech (TTS) system,[159] showing the value of local knowledge when serving local markets. Just as importantly, they are 60 times more cost-effective,[160] designed for Pakistan's low connectivity and bandwidth and limited compute capacity. By focusing on a limited number of languages and domain-specific use cases, Uplift has created speech models that are relatively small, and therefore more effective, in the settings that need it most.

159. Uplift AI
160. Ibid.

SPOTLIGHT 5: KENCORPUS IS LAYING THE FOUNDATION FOR INCLUSIVE AFRICAN AI SYSTEMS

African languages are largely missing from mainstream AI datasets and tools, leaving millions of people unable to access digital information, education or public services in the language they are most comfortable with. To address this, KenCorpus[161] is building datasets and AI models for five African languages, including sign language.

The initiative was founded by Maseno University, the University of Nairobi and Africa Nazarene University in 2021. KenCorpus' community-driven approach to collecting and labelling language data has so far produced around 500 hours of data. KenCorpus also builds AI models around these datasets, focusing on machine translation (text-to-speech, speech-to-text) and text or speech synthesis. It is beginning to apply these models across digital health, agricultural and public services through grant-funded projects.

KenCorpus' language data includes Kenyan Sign Language (KSL) and sign language translation models, which are particularly valuable in the education sector. They can render speech into an avatar KSL representation in real time, enhancing accessibility and inclusion for deaf students in mixed classrooms. The project is in the prototype phase and, as with several impactful efforts on the continent, needs sustainable funding to scale.

A BRIEF ON THE KENCORPUS PROJECT

Project Phases

- Data Collection
- Transcription & Annotation
- Speech To Text Q&A

Access Language Resources

- Access Corpus Data
- Perform text processing on input texts
- Ask questions based on input text and receive answers

Our Community

- Researchers
- Linguistics Analysis Team
- Developers
- African Language Enthuthiasts

Source: KenCorpus

161. KenCorpus

Fintech for education

Case study: **InvestEd**

Context

Across LMICs, low-income students frequently experience limited access to affordable and flexible education financing. According to the World Bank's Global Findex Database 2025, 49.8% of the Philippines' 82 million adults aged 15 and over remain unbanked, lacking access to formal financial services.[162] Among these, students represent one of the most financially excluded groups. Traditional lenders classify students as high-risk borrowers due to the absence of formal credit histories, collateral or stable income, effectively excluding them from formal credit systems.

Although mobile phone ownership stands at 72%[163] for Filipino adults and more than 28% have a mobile money account,[164] current fintech solutions rarely address the needs of young people, who may not have generated sufficient mobile transaction data to qualify for loans over $100. In the absence of government subsidies, students are often forced to either abandon their education or fall victim to financial extortion by loan sharks who impose exorbitant interest rates that trap them in cycles of debt.

This financial exclusion leads to higher student dropout rates, underemployment and ongoing economic challenges across generations.

About InvestEd

Founded in 2016, InvestEd is an impact business based in the Philippines that strives to address the lack of access to higher education and unemployment for underprivileged youth in the country, especially first-generation college students from low-income households. The company's core offering is student loans, providing non-collateral financing for tuition, gadgets, rent and other educational expenses. What distinguishes InvestEd is its proprietary AI-powered credit-scoring and risk-control algorithm, designed to assess students who are typically considered "unbankable" by traditional financial institutions. This AI-driven approach enables the company to offer customised and flexible repayment plans that often begin after the student has graduated and secured employment. To ensure borrowers are successful and maintain high repayment rates, the loans are bundled with a comprehensive coaching programme covering financial literacy, career development and self-management to help students stay on track and build financial discipline.

Organisation profile

Year founded: 2016

Business type: For profit

Maturity stage: Seed

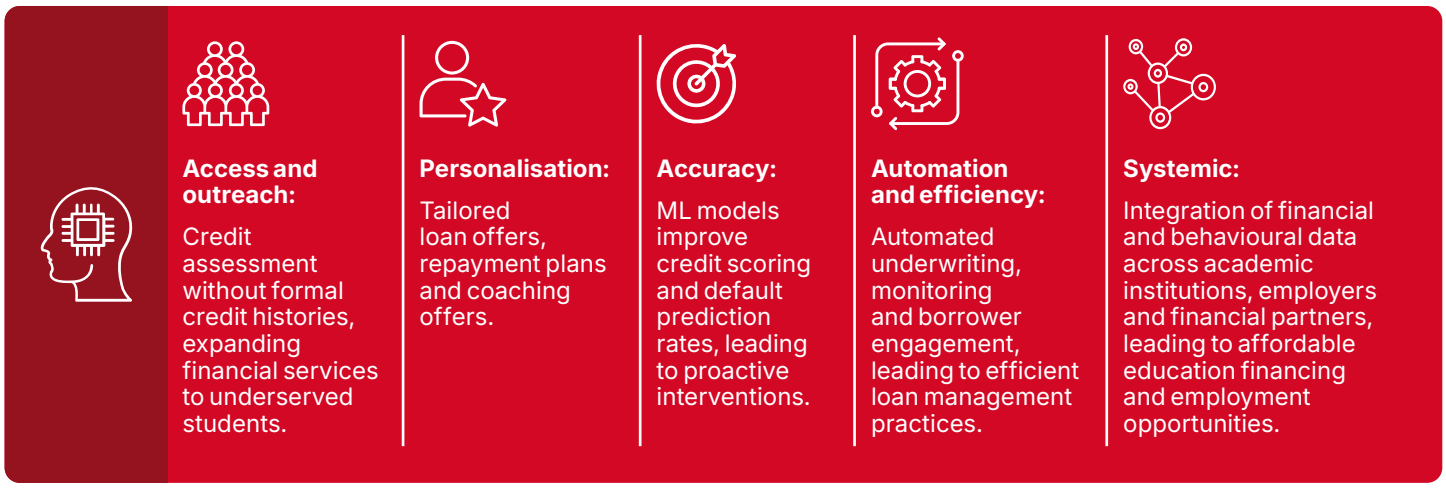
Funding: Debt, equity and grant funding

Team size: About 43 staff

Geography: Philippines

162. World Bank. (2025). *The Little Data Book on Financial Inclusion*.
163. GSMA. (2025). *The State of the Industry Report on Mobile Money 2025*.
164. World Bank. (2025). *The Little Data Book on Financial Inclusion*.

Figure 37: The value AI adds to InvestEd



Source: GSMA (2025)

AI solution and architecture

In 2018, InvestEd began by providing small, flexible student loans aimed at covering tuition for college and vocational students who were traditionally excluded from the formal credit system. The company later added non-financial support services, including financial literacy programmes, success coaching and career transition guidance, helping students manage their loans responsibly and prepare them for employment after graduation. Over the next few years, the company expanded its product range to cover gadget, dorm rent, thesis and board exam loans, addressing the broader financial needs of students. As InvestEd's loan portfolio grew, so did its proprietary dataset on student borrowers, representing diverse academic backgrounds, repayment patterns and behavioural indicators, enabling the company to transition to AI-driven credit scoring and underwriting for student borrowers.

Currently, InvestEd's digital lending platform leverages a proprietary ML predictive AI model – named Alvin AI – at the underwriting stage, where it evaluates demographic, academic and socio-economic data from the loan application to estimate the probability of default, generate a risk score and produce a customised loan offer. Once the student has accepted the loan offer and submitted all necessary documentation and guarantor details, the loan funds are disbursed directly to the designated service provider for the specified loan purpose, ensuring appropriate use of the funds. Using this AI model, InvestEd conducts credit assessment without depending on formal credit histories and can detect non-linear patterns and interactions in many small signals that standard logistic regression-based[165] credit-scoring models miss, improving approval accuracy and enabling faster, automated decisions at scale, while reducing manual underwriting costs.

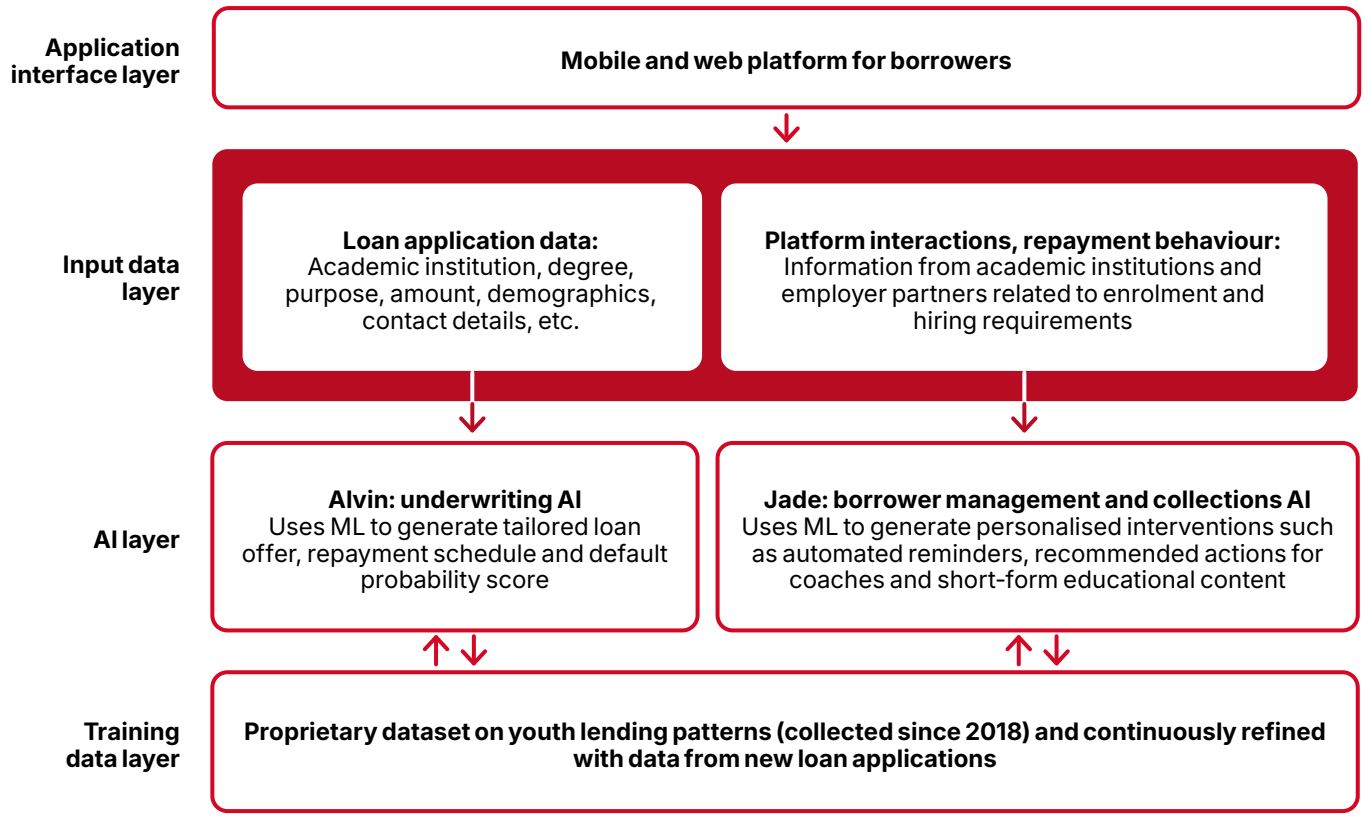
The company intends to introduce a second AI model, named Jade AI, which will be used to recommend the best course of action to its coaches, collectors and customer services team by monitoring borrowers' repayment behaviour, academic performance, communication patterns, personal values, lifestyle factors, work experience and relevant life events after loan disbursement. This prescriptive AI[166] model will leverage self-reported data from students, interactions with coaches and collectors, platform usage data and information obtained from academic institutions and employer partners related to enrolment and hiring requirements. Jade AI will assist in determining what types of interactions will maximise collection rates and user satisfaction during the repayment journey. It will deliver personalised interventions such as automated reminders, recommended actions for coaches and short-form educational content tailored to each student's risk profile and needs.

165. Definition by IBM.

166. Prescriptive AI builds upon predictive models. It does not just tell you what might happen; it analyses potential actions and recommends or directly executes the optimal next steps needed to achieve specific goals.

InvestEd aims to use Alvin and Jade AI to reduce human-based judgement and decision-making across the student borrower journey, from loan application to collections and recovery, while regularly retraining and refining the models using InvestEd's proprietary dataset, allowing the platform to enhance its predictive accuracy and responsiveness over time.

Figure 38: InvestEd's AI architecture and data flow



Source: GSMA (2025)

Figure 39: InvestEd AI model definitions

ALVIN & JADE Definitions

Term	Type	Definition
ALVIN	**Predictive Model** *"What will happen?"*	Refers to our scorecards or models that have the primary goal to predict repayment performance. Oftentimes, the objective of these models is to produce Probability of Default, Internal Rate of Return, etc. ALVIN has now evolved from the name of an algorithm to a group of borrower performance prediction models. **Example:** "This borrower is 30% likely to default and if they do not default, you will earn 43% /annum from them."
JADE	**Prescriptive Model** *"What should we do about it?"*	Refers to a model under development that would recommend the best course of action to our Coaches, Collectors, and Customer service to achieve a desired outcome, often using predictions as inputs. This is to remove human judgment-based decision making for a more scalable and performing lending operations. **Example:** "Given that the borrower is predicted to be materialistic when he gets 1st paycheck in 2 months, I recommend the collectors be strict while coaches should send a budgeting worksheet."

Source: InvestEd

Technology profile	
Type of AI:	Predictive AI, prescriptive AI
Type of technology used:	ML, predictive analytics
Main users:	Low-income tertiary students, aged 18–30
Delivery channels:	Mobile app and website

Business model

InvestEd operates on a multi-faceted business model, generating approximately 95% of its revenue from student loans, primarily earning income from interest, service fees and late payment penalties, while partnering with educational institutions for direct loan disbursement and academic monitoring. These loans are financed by a community of individual and institutional investors, referred to as "impact funders". Central to InvestEd's lending model is its profile-based coaching intervention integrated in the borrower journey. This coaching serves to both reduce the risk of default and educate students on personal finance principles, thereby improving their creditworthiness and long-term financial health.

The entire business model is data-driven, relying on the continuous flow of detailed borrower data from the Gen Z[167] demographic. Students, in return, receive the critical value of funded education and financial coaching, creating a mutually beneficial ecosystem that fuels both InvestEd's analytical capabilities and its mission for financial inclusion.

The core lending business, while foundational, is low-margin and capital-intensive, as InvestEd custom-built everything from scratch, and education loans typically come with relatively long return cycles. To diversify revenue and improve margins, InvestEd has developed three additional profitable revenue streams that leverage the high-quality, representative data collected from its lending activities.

The first stream, Youth Lending Services, includes earnings from service and programme fees as well as loan book purchases from partner financial institutions. The second, Gen Z Services, involves companies paying InvestEd fees to engage with and promote products to its Gen Z borrower base, allowing companies to test and acquire young consumers effectively. The third revenue line, Talent Recruitment, charges employers' subscription fees for access to InvestEd's database of graduates and fees per successful hire from its borrower community. These three streams are high-margin and relatively low-overhead, as InvestEd incurs costs upfront but receives ongoing payments once services are delivered.

The company follows a blended finance approach, combining philanthropic capital, investments from high-net worth individuals and commercial lenders. This financing model enables InvestEd to offer affordable loans while maintaining operational sustainability. While not yet profitable, it aims to reach break-even by 2026. InvestEd has gained strong market traction, with 99% year-on-year customer growth. To date, it has secured $7 million in funding and continues to build partnerships to support scale and long-term viability.

167. People born between 1996 and 2010. McKinsey. (28 August 2024). "What is Gen Z?".

Partnerships for impact

InvestEd actively partners with microfinance institutions (MFIs) and community organisations in the Philippines to expand its reach and impact. Partnerships with Grameen Microfinance[168] and the Ramon Aboitiz Foundation, Inc. (RAFI)[169] focus on providing affordable educational loans to the children of female borrowers, while collaboration with Lalamove Philippines[170] targets education financing for the children of Lalamove drivers. These partnerships function both as customer and employee engagement programmes for the partners and as growth channels for InvestEd's loan book. Additionally, InvestEd supports entrepreneurial students by offering small business loans through select partners, enabling students to pursue side businesses alongside their studies.

Figure 40: InvestEd business model canvas

Key partnerships

- Funding and investment partners, including high-net worth families and commercial lenders
- MFIs (e.g. Grameen Microfinance) serving female borrowers' children
- Foundations (e.g. Ramon Aboitiz Foundation, Inc.) providing community access
- Employer partners for borrower employment support
- Educational institutions facilitating direct loan disbursements and data exchange

Key activities

- Loan underwriting and credit assessment via AI models
- Loan disbursement and repayment management
- Personalised coaching and financial education delivery
- Data analysis and AI model training with borrower data
- Partnership development and ecosystem management
- Marketing and outreach to borrowers and commercial partners

Value propositions

- Affordable, accessible loans through AI-driven credit scoring and risk assessment tailored for education finance
- Personalised one-on-one coaching to improve borrower financial capability and reduce defaults
- AI-based credit scoring as a service for banks, MFIs and digital lenders
- High-performing talent recruitment services for employers
- Gen Z behavioural insights for consumer brand companies

Customer relationships

- Personalised coaching throughout the loan life cycle
- AI-driven automated reminders and behavioural nudges
- Employer and partner relationship management for collaborative growth

Customer segments

- Students and parents
- Banks, MFIs and digital lenders
- Employers
- Consumer brand companies
- Farmer cooperatives

Channels

- Mobile app and website
- Partnership networks (MFIs, foundations, employers, etc.)

Key resources

- Proprietary AI models (Alvin AI, Jade AI) for credit scoring and borrower coaching
- Custom-built digital loan management platform
- Extensive borrower data and behaviour insights collected over years
- Strategic partnerships with MFIs, schools and employers
- Funding from philanthropic capital, investors and commercial lenders

Revenue streams

- Direct student lending (95% of revenue) via interest, service fees and late penalties
- Youth Lending Services: service fees, program fees and loan book sales
- Gen Z Services: fees from companies for product promotions and consumer insights
- Talent Recruitment: Subscription and per-hire fees from employers accessing graduate database

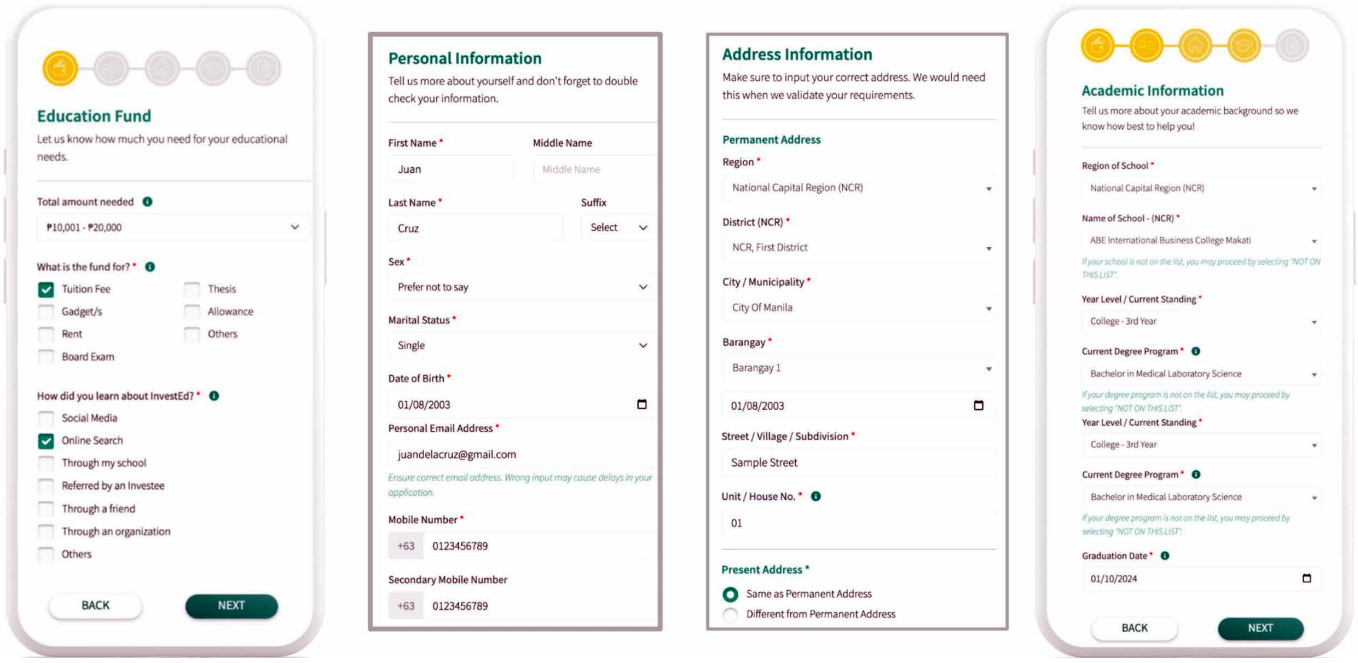
Cost structure

- AI technology research and development
- Platform maintenance costs- AI model development and continuous training expenses- Loan capital and financial risk management costs
- Operational costs including coaching, customer support and compliance
- Partnership management and marketing expenses

Source: GSMA (2025)

168. Grameen Microfinance Pilipinas
169. Ramon Aboitiz Foundation Inc.
170. Lalamove

InvestEd online loan application



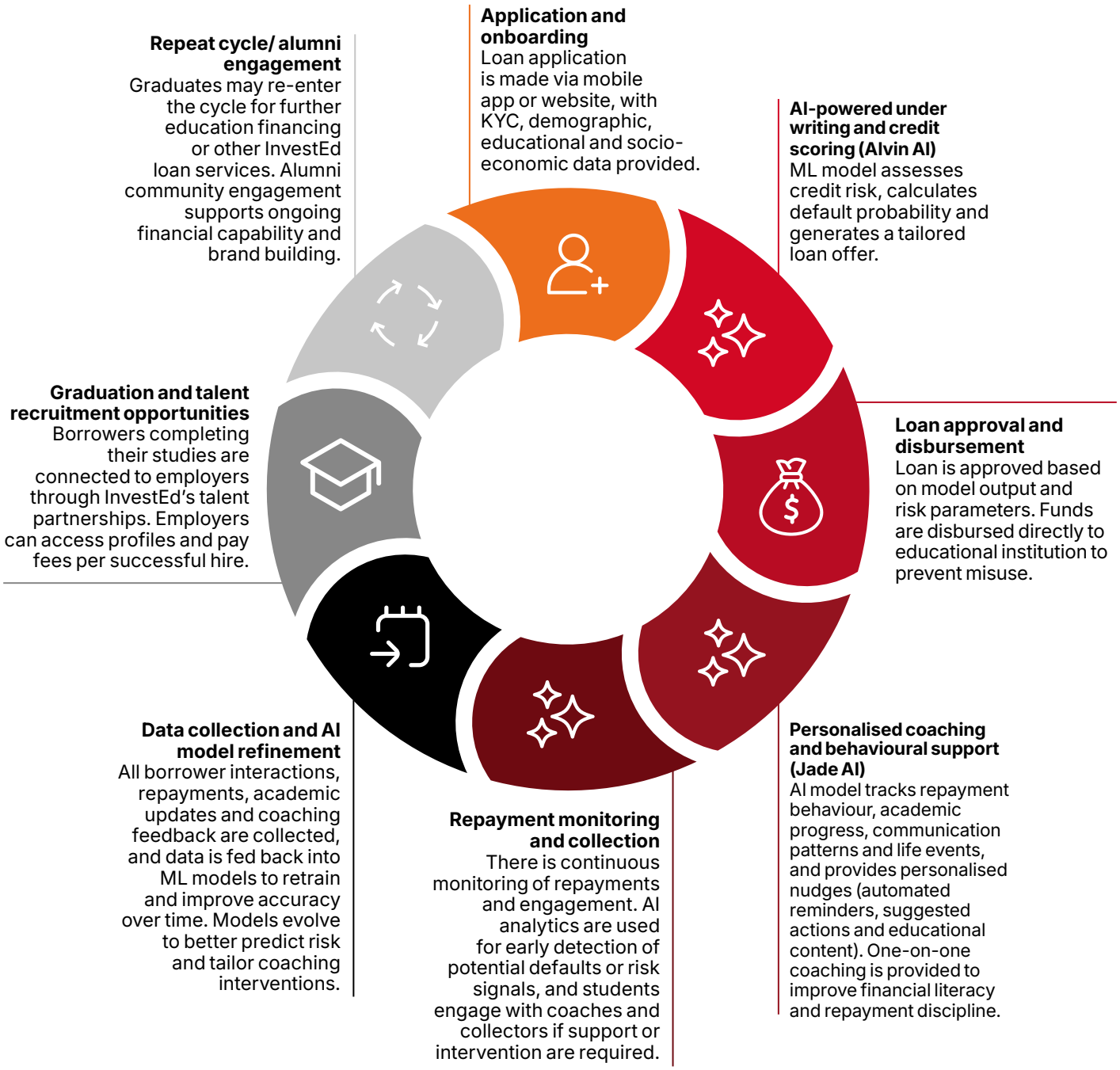
Source: InvestEd

Impact and results

InvestEd addresses financial, structural and behavioural barriers that hinder low-income students from completing higher education by combining affordable credit access with personalised coaching and data-driven support. Its platform enables students from underprivileged backgrounds – traditionally excluded from formal financial systems due to a lack of collateral or credit history – to secure education loans with tailored risk assessment powered by proprietary AI models. This inclusive approach fosters access to higher education for underserved populations across the Philippines.

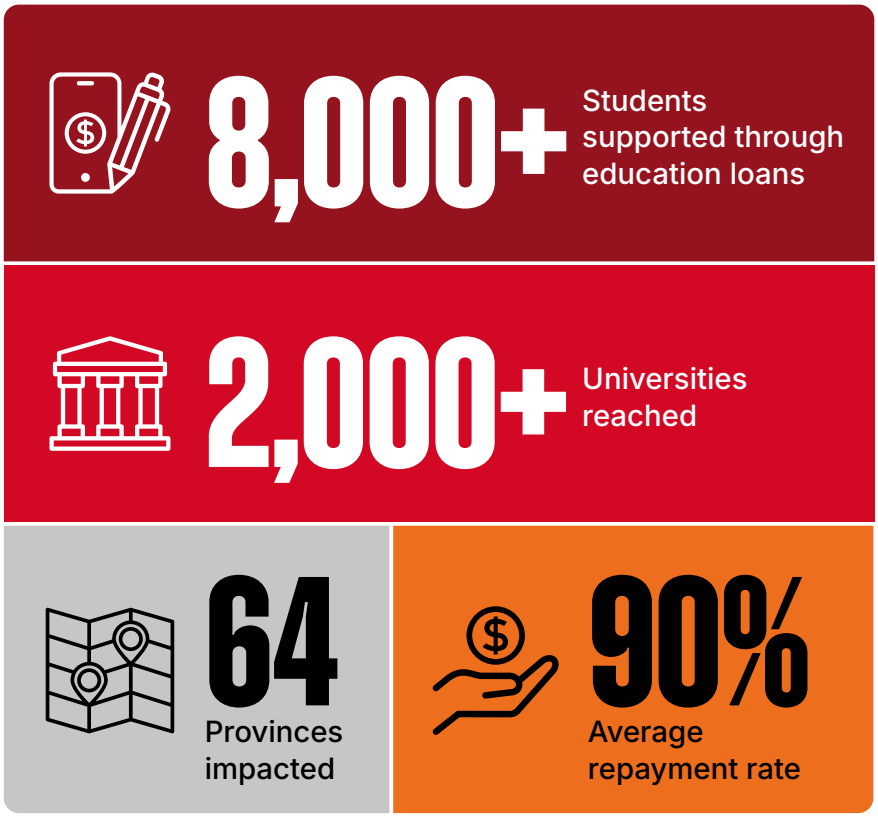
Students and parents can apply through a mobile app or website, which guide users through onboarding, loan application, approval and disbursement. Loans are disbursed directly to educational institutions to minimise misuse, ensuring funds are applied strictly towards tuition and related academic expenses. After disbursement, borrowers receive AI-powered nudges, short educational videos and behavioural content designed to promote repayment discipline, emotional resilience and financial literacy. This approach helps reduce dropout rates while building long-term financial capability.

Figure 41: InvestEd user journey



Source: GSMA (2025)

To date, more than 8,000 unique students from more than 2,000 universities in 64 provinces have taken loans from InvestEd.[171] The borrower profile shows that 81% of borrowers are classified as low-income to poor, 48% are the first in their family to attend college, 67% are female and 52% had previously stopped schooling due to financial constraints, family issues or teenage pregnancy. 62% are from households that have previously borrowed from predatory lenders. InvestEd's after-graduation support results in its borrowers securing employment within 45 days of graduation, on average. InvestEd reports average repayment rates of more than 90% while maintaining a 100% lender renewal rate. These metrics suggest both strong social impact and promising financial resilience.



Challenges and future outlook

InvestEd faces several challenges as it pursues its growth and impact ambitions. The lack of existing credit data on students in the Philippines compelled the company to develop its own datasets from scratch, a process that may need to be repeated or adapted for new markets as it expands. Its core direct lending business required significant upfront capital and entails long repayment cycles, resulting in lower margins and delayed profitability. As operations scale, InvestEd must maintain the quality and integrity of borrower data, which underpins both its AI-driven risk assessment and behavioural intervention systems. Managing default risk through ongoing coaching and personalised nudges adds to the operational complexity, requiring a blend of technology and human expertise.

InvestEd is evolving its platform into a modular solution for diverse education and financial sector partners, scaling its B2B offerings to MFIs, banks, digital lenders, universities and consumer brands. This expansion involves educating partners about AI-based credit-scoring methods and behavioural analytics, which requires transparency and adherence to regulations and data privacy standards. While InvestEd increasingly leverages AI for automation, personalisation and predictive accuracy, it must also mitigate the associated risks, such as data bias and over-reliance on automated decision-making.

InvestEd's path to commercial sustainability depends on diversifying beyond low-margin direct lending to high-margin business streams like credit scoring as a service, Gen Z consumer insights and talent recruitment solutions, and converting these into scalable, stable revenue streams. InvestEd's strong loan portfolio performance and consistently high repayment rates have drawn interest from commercial lenders and financial institutions. These entities are exploring partnership models whereby InvestEd acts as a facilitator – connecting students with financial institutions that provide the capital while earning a service fee for each loan processed.

The company's ability to collect high-quality and representative borrower data, maintain robust partnerships, continuously improve its models and manage risk will determine whether it can deliver scalable social impact, achieve financial viability and meet its target of profitability by 2026.

171. InvestEd

Fraudtech
Financial inclusion

Case study:
Orca Fraud

Context

In the rapidly expanding digital finance ecosystems of LMICs, fraud is becoming a greater risk. As mobile wallets and instant payment systems grow, mobile money users, particularly those from low-income groups, are exposed to fast-changing and sophisticated fraud tactics.

According to the South African Banking Risk Information Centre (SABRIC), there were significant increases in financial crime in 2024, including digital banking fraud, application fraud and card-related crime.[172] Emerging technologies, particularly GenAI, have been used by criminals to craft more sophisticated fraud schemes, contributing to an unprecedented 86% increase in digital banking fraud incidents and a 74% rise in associated losses, amounting to R 1.888 billion ($111 million).[173]

Traditional fraud detection tools, often designed for high-value transactions in developed markets, struggle to capture the unique behavioural and transaction patterns found in LMICs. These systems are prone to produce false positives that block legitimate users while failing to detect small, coordinated attacks typical of mobile-first environments. The result is a loss of trust in digital finance, deterring adoption among the very populations these innovations seek to serve.

About Orca Fraud

Orca Fraud is a fraudtech startup headquartered in South Africa, specialising in modular, AI-powered fraud detection and compliance solutions for financial service providers (FSPs) in emerging markets. The company's platform is built to address a range of fraud scenarios, including account takeovers, investment scams, SIM swap fraud and money muling, among others.

Its system is designed for rapid deployment, adaptable to varying levels of data maturity and focused on enabling safe and inclusive digital finance at scale.

Orca Dashboard sample view

Source: Orca

Organisation profile

Year founded: 2024

Business type: For profit

Stage: Early stage

Funding: Pre-seed

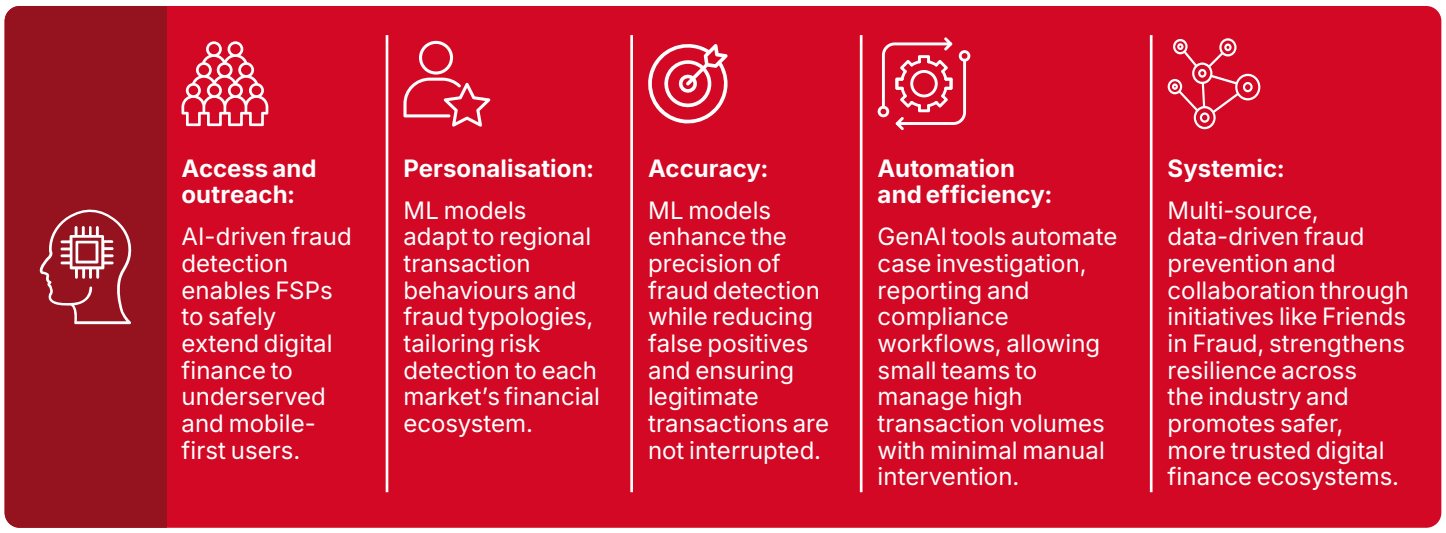
Team size: Under 10

Geographies: Africa and Latin America

172. South African Banking Risk Information Centre. (2024). *Annual Crime Statistics 2024*.

173. Ibid.

Figure 42: The value AI adds to Orca Fraud



Source: GSMA (2025)

AI solution and architecture

At the core of Orca's fraud prevention platform are proprietary machine learning (ML) models that continuously learn from transaction data, behavioural signals and regional fraud typologies. Designed specifically for emerging market contexts, these models go beyond traditional rule-based systems by detecting new and evolving patterns of fraud in real time.

These advanced models continuously analyse transactional data, detecting suspicious activities as they occur, such as sequences of transfers that do not align with a user's typical behaviour, spikes in microtransactions and coordinated signals of potential attacks spread across multiple accounts.

Orca's system is built on top of conventional transaction monitoring by integrating multi-source data inputs. These include telco-derived signals (e.g. calls under duress or phishing-related SMS patterns) and contextual signals about typical transaction behaviour in LMIC markets. This holistic approach enhances the accuracy of fraud detection and ensures relevance in environments where formal financial histories are limited.

A key innovation is Orca's use of unsupervised learning[174] techniques to identify anomalies and emerging threats before they materialise. These models reveal patterns indicative of large or coordinated fraud schemes that may not yet have been labelled as such. Complementing this are GenAI-enabled, "co-pilot"-style interpretability tools that help compliance teams understand why a transaction or user has been flagged. These tools provide transparency into model reasoning – an essential requirement for regulated industries – and enable faster, more intuitive investigations and report generation.

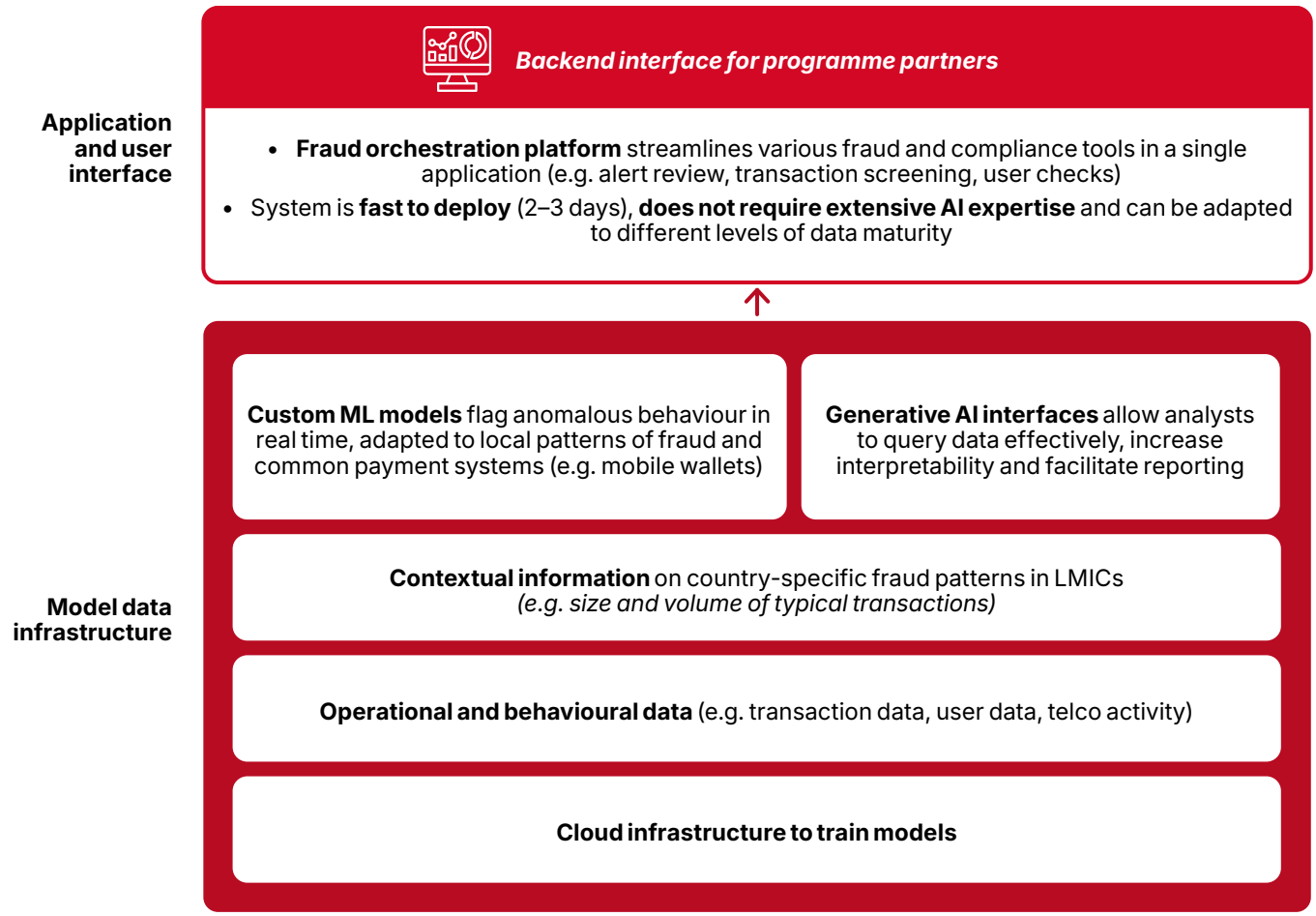
To support decision-making, every transaction or event is scored for risk. Risk thresholds are configured by each client and calibrated to their specific risk tolerance or regulatory requirements. High-risk cases are automatically prioritised for human review, while low-risk alerts can be auto-resolved or deferred.

The platform runs on a cloud-native infrastructure, supporting both SaaS[175] and hybrid deployments to accommodate regulatory or infrastructure constraints in different countries. Cloud deployment enables fast, lightweight integration and ensures the platform performs even in low-data environments.

The fraud orchestration platform integrates different tools, such as alert systems, transaction screeners and user behaviour checks, within a single application, reducing operational fragmentation. Deployment is rapid (often within two to three days), with minimal technical expertise required on the client side, making it accessible even for smaller or less mature institutions.

174. Unsupervised learning uses ML algorithms to analyse, find patterns in and group unlabelled data sets, without human intervention. IBM. "Unsupervised Learning".
175. Software as a service (SaaS) is a cloud-based software delivery model in which providers host applications and make them available to users over the internet. IBM. "What is SaaS?"

Figure 43: Orca Fraud AI architecture and data flow



Source: GSMA (2025)

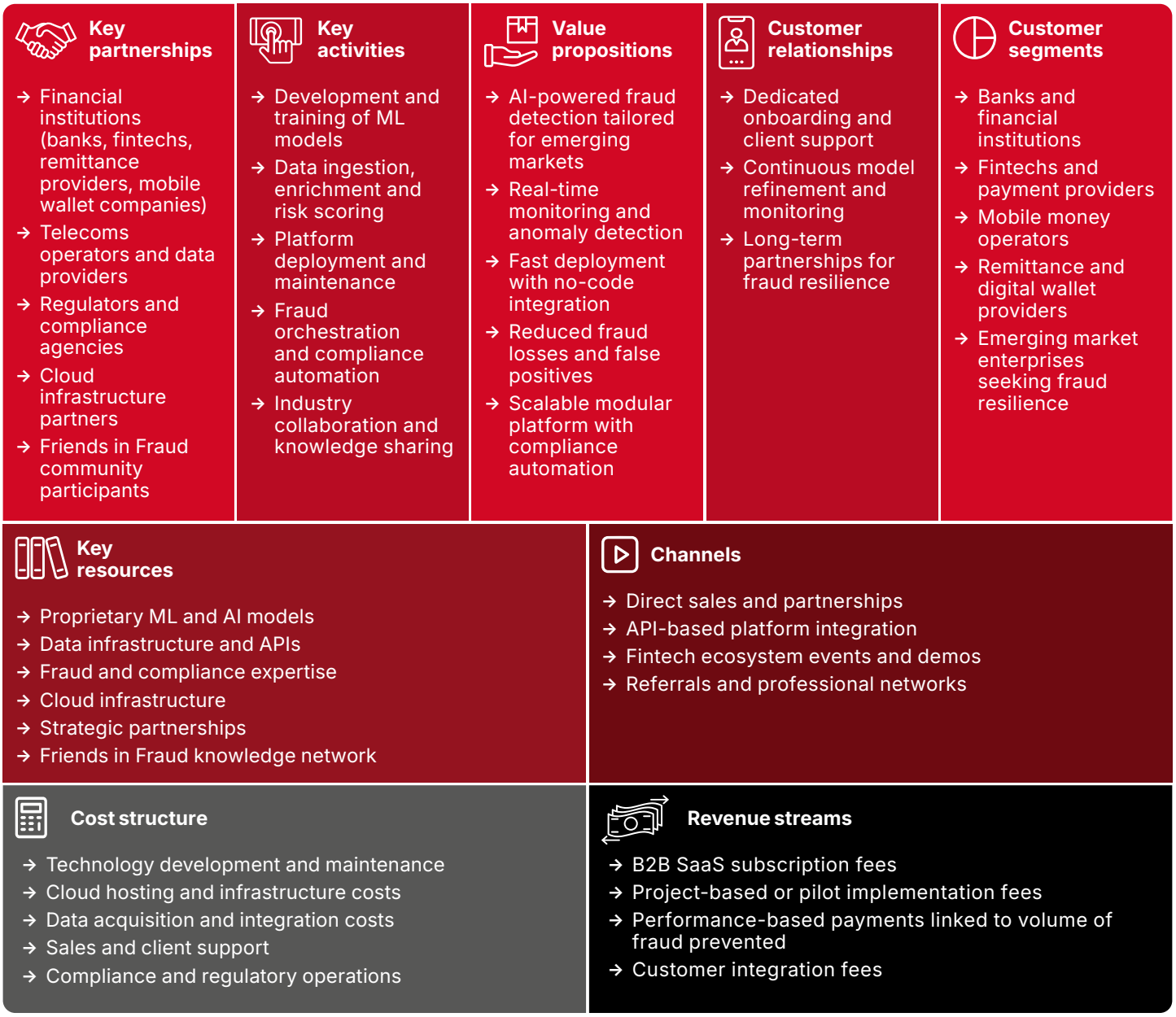
Technology profile

Type of AI:	Predictive AI, GenAI
Type of technology used:	ML, predictive analytics, NLP
Main users:	Banks, mobile money operators, payment service providers (PSPs)
Delivery channels:	Direct system integration, web platform

Business model

Orca operates on a B2B SaaS model. Financial institutions such as banks, mobile money operators and remittance providers subscribe to Orca's modular fraud detection tools. Pricing is based on volume and typically calculated by the amount of fraud prevented, aligning Orca's incentives with client outcomes. This shared-value, results-driven pricing model is particularly attractive in emerging markets where budgets are constrained and FSPs are highly sensitive to return on investment (ROI). The modular architecture also allows clients to adopt only the tools they need, ensuring affordability and flexibility for organisations with different levels of digital maturity.

Figure 44: Orca Fraud business model canvas



Source: GSMA (2025)

Collaborative intelligence: the Friends in Fraud network

Complementing its value-driven business model, Orca has established Friends in Fraud – a professional community that connects fraud and compliance specialists across financial institutions, fintechs and telecoms operators. The initiative facilitates the sharing of fraud typologies, behavioural insights and emerging risk signals, creating a collective intelligence layer that strengthens detection capabilities across the industry. By fostering open dialogue and cross-sector learning, Friends in Fraud enables institutions to stay ahead of evolving fraud patterns while contributing to more resilient digital finance ecosystems.

Impact and results

Orca helps financial institutions detect anomalous behaviour in real time using custom-built ML models trained on local transaction patterns. By identifying threats early and with greater precision, even small compliance teams can address rapidly evolving risks without significant technical expertise.

Orca Fraud is working in partnership with financial institutions in more than 70 countries across Africa and Latin America from its Cape Town headquarters, helping clients reduce fraud losses and build user trust in digital financial services.

By enabling fast, localised fraud detection, Orca helps reduce fraud-related losses, protect vulnerable users and preserve trust in digital finance. For example, in Kenya, a large fraud syndicate was identified by Orca through mobile number prefixes, demonstrating the importance of detecting regional patterns.

Its real-time detection tools have allowed providers to proactively block fraud without limiting access for legitimate users. The platform is already being used to protect high-volume, low-value financial flows in mobile-first markets.

Partnering with Orca has enabled clients to scale rapidly into new markets while maintaining strong fraud protection and regulatory compliance.

For example, Sling Money,[176] a mobile app for instant global payments, partnered with Orca to integrate its financial crime solutions – purpose-built to support diverse payment rails and emerging markets. Sling Money had a robust transaction monitoring solution in less than 60 days that allowed it to expand into African and Latin American markets and operate in 20 to 25 countries.[177]

Orca's clients also benefit from a significantly reduced engineering burden as they can mitigate fraud and meet compliance requirements without writing code, leveraging Orca's API-driven, modular tools to integrate the fraud and compliance stack. This speeds deployment, reduces costs and lets teams focus on local behaviours, user experience and scaling, rather than building and maintaining the fraud infrastructure themselves.

Challenges and future outlook

Limited access to localised, high-quality data

Orca has encountered several challenges in its pursuit of growth, which are compounded by the complexities of operating in a highly regulated and sensitive industry. A major barrier is the limited availability of diverse, high-quality data sources essential for creating accurate and locally relevant fraud detection tools. This is a particular challenge in LMICs where fraud takes different forms than in high-income countries (HICs) – a reflection of different payment methods, such as mobile wallets and merchant networks, as well as unique socio-economic and cultural nuances. In many regions, data-sharing frameworks between financial institutions and telcos are limited, constraining Orca's ability to build robust fraud detection models.

Building trust in AI-driven fraud detection

Another challenge is establishing trust and credibility with potential clients, many of which still rely on manual or rule-based fraud systems. Demonstrating that AI fraud prevention solutions are consistently reliable and accurate is essential for institutions to be willing to transition to automated, data-driven approaches. Variable

176. Sling Money

177. Orca. (15 July 2025). "How Sling Money launched in 20+ countries using Orca Fraud".

infrastructure, regulatory environments and privacy frameworks are also obstacles that make cross-border expansion demanding.

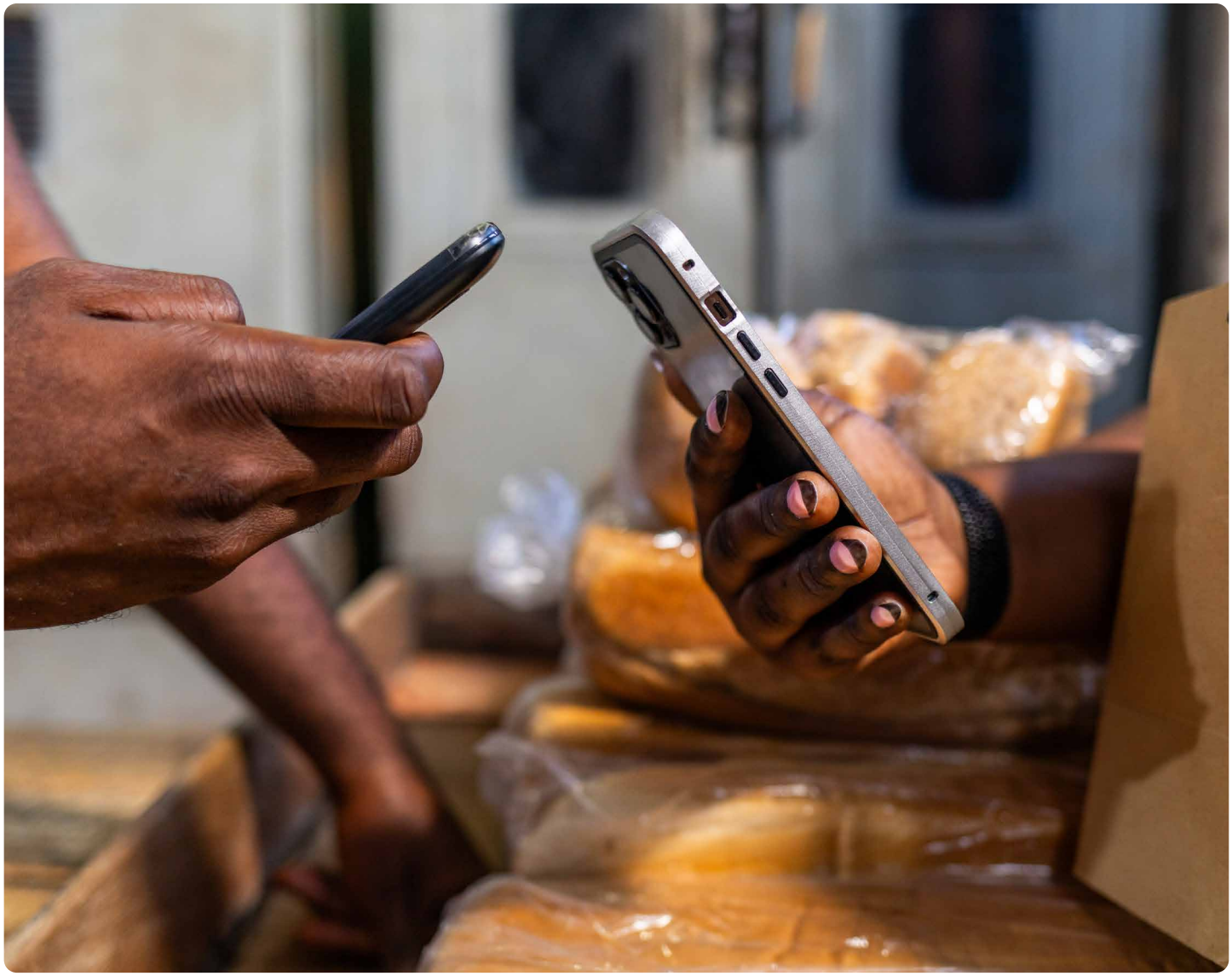
Strategies for overcoming challenges

Orca's strategy identifies several concrete ways to address the challenges it faces.

First, it has prioritised deeper integration with telcos and alternative data providers to access richer, telco-derived signals such as device and SIM change histories, communication metadata and location or contextual data. This approach will help the company better detect the complex fraud patterns common in emerging markets. The company is also planning selective expansion into mobile-first, high-growth markets such as Kenya and Brazil, where mobile wallets are dominant and there is a significant gap between existing fraud tools and local user behaviour.

On the product side, Orca is focused on advancing automation in compliance workflows. By leveraging AI to reduce human intervention and reduce response times, the company aims to support clients in meeting regulatory requirements while maintaining operational efficiency.

With its adaptive technical architecture and mission-driven business model, Orca is positioning itself as a critical player in safeguarding digital finance ecosystems. Its long-term vision is to foster safer, more trusted systems of digital finance that uphold and expand financial inclusion sustainably.



Fraudtech / Retail digitalisation and embedded finance

Case study: **&frnds**

Context

Micro, small and medium-sized enterprises (MSMEs) are the backbone of Asia's economies, representing 98.7% of all businesses, employing nearly two-thirds of the workforce and contributing 38.3% of national economic output for developing Asia.[178]

In the Philippines, there are more than 1.24 million MSMEs, accounting for 99.6% of all businesses.[179] Approximately 50% of these enterprises operate in the wholesale and retail trade sector,[180] underscoring its vital role in the country's economy. The Philippines is also home to an extensive network of more than 1.3 million "sari-sari" stores – neighbourhood shops selling everyday essentials like food and household items in small, affordable quantities.[181] These microbusinesses are a significant source of employment in the informal economy and a source of livelihood for many Filipino families. Importantly, about 75% of sari-sari store owners are women,[182] and women lead more than 55% of all MSMEs nationwide.[183]

Indonesia similarly boasts a thriving MSME sector, with more than 62 million MSMEs[184] representing 99% of all businesses.[185] Again, wholesale and retail trade are a key driver of economic activity, with more than 14 million enterprises engaged in it.[186] The country's famed network of 3.5 million "warungs"[187] – family-owned corner shops – serve as vital commercial and social hubs in communities. Women play a prominent role, owning or managing nearly 65%[188] of Indonesia's MSMEs, especially micro and ultra-micro enterprises like warungs.

Despite their economic importance, many micro and small retailers continue to operate informally. They often lack credit histories or digital records, which presents significant obstacles to accessing finance and participating in formal supply chains. At the same time, wholesalers in these markets operate largely offline and are typically undercapitalised. This limits their capacity to manage stock efficiently or expand their reach.

For local and global fast-moving-consumer-good (FMCG) companies and FSPs, these realities create persistent blind spots at the last mile. Granular data on sales, stock and vendor behaviour are largely unavailable, while fragmented, informal distribution structures complicate both oversight and market penetration. Bridging these last-mile data and financing gaps remains critical, not only to drive MSME growth but also unlock more inclusive, efficient and resilient commerce across Southeast Asia.

About &frnds

Headquartered in Singapore, &frnds is a technology company digitalising the last mile of FMCG distribution in emerging markets through a business-to-business-to-consumer (B2B2C) platform. Operating in Indonesia and the Philippines, &frnds partners with local FMCG wholesalers to digitalise their operations and offer de-risked credit to local merchants and microretailers.

178. Asian Development Bank. (2024). *Asia Small and Medium-Sized Enterprise Monitor 2024*.
179. Department of Trade and Industry. (2023). "MSME Statistics".
180. MSMED Council. (2024). *Micro, Small, and Medium Enterprise Development Plan 2023–2028*.
181. Asian Preparedness Partnership (APP). (15 October 2020). "Never too Small for Hope - Part I (Sari-sari store)".
182. Philippine Institute for Development Studies (PIDS). (10 March 2025). "Sari-sari stores drive women's empowerment in the Philippines — study".
183. OECD. (2025). *Women entrepreneurship in remote areas in Indonesia and the Philippines*. OECD Global Relations Policy Papers. Volume 2025, Issue 1.
184. ADB. (2024). *Asia SME Data Monitor: Indonesia*.
185. Indonesian Chamber of Commerce and Industry. (2024). "Indonesia MSMEs".
186. Ibid.
187. The Jakarta Globe. (28 September 2022). "Study Confirms Role of Warungs in Indonesia's Digital Economy".
188. OECD. (2025). *Women entrepreneurship in remote areas in Indonesia and the Philippines*. OECD Global Relations Policy Papers. Volume 2025, Issue 1.

Their asset-light approach distinguishes &frnds from traditional models, as it requires no capital expenditure (CapEx), holds no inventory and does not rely on subsidies. Instead, &frnds employs a sales team of commerce managers to deliver a comfortable balance of tech and touch to wholesalers, merchants and microretailers. These commerce managers not only take operational responsibility for digitalising wholesalers but also help merchants place their orders via the digital interface, enabling wholesalers to boost their profits significantly by lowering costs and increasing sales, while also providing merchants with reliable 24-hour delivery services.

&frnds' partners include Microsoft (for AI technology), Mastercard (for financial inclusion), the International Finance Corporation (IFC) and several large consumer brands.

Organisation profile

Year founded: 2014

Business type: For profit

Stage: Later-stage VC

Funding: Venture capital-backed

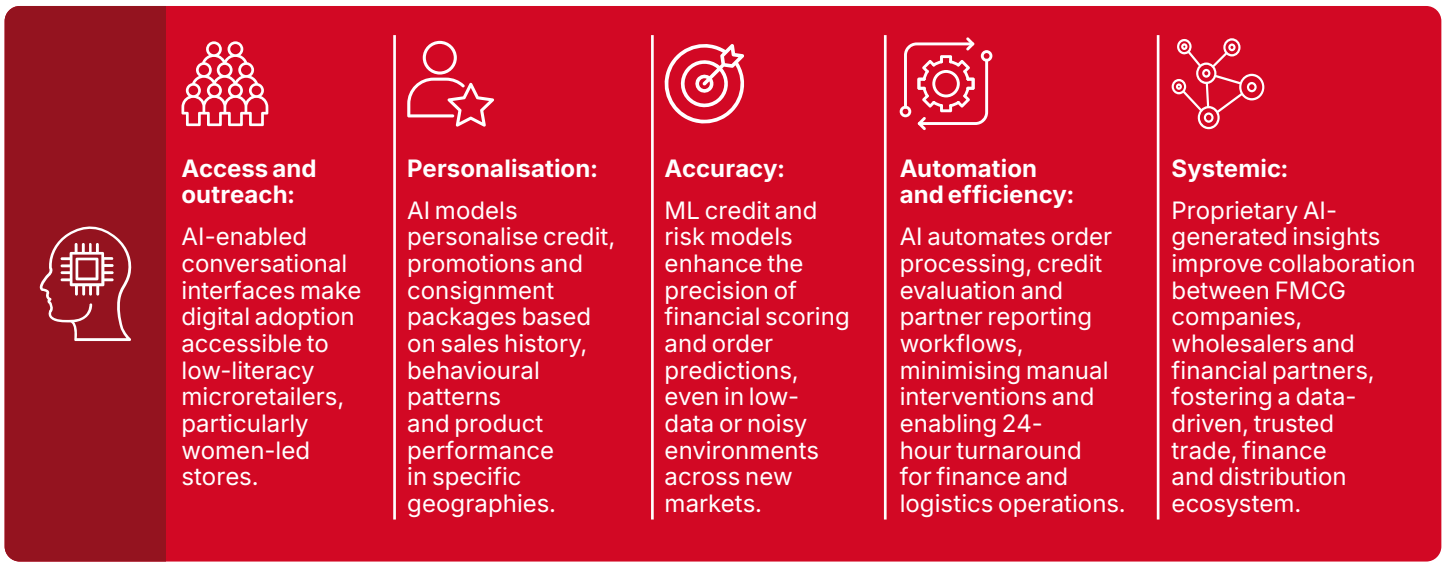
Team size: About 500 staff

Geographies: Philippines and Indonesia (expanding to Vietnam)

Shopkeeper using the &frnds app

Source: &frnds

Figure 45: The value AI adds to &frnds



Source: GSMA (2025)

AI solution and architecture

&frnds' unique integration of AI, big data and human-centred design (HCD) enables it to digitalise last-mile FMCG distribution and empower microretailers in emerging markets. The company has developed a technology platform that digitalises entire local supply chains, linking FMCG brands, wholesalers and informal retailers in a data-driven ecosystem.

&frnds is in the unique position of having sole access to the granular commerce data collected by its commerce managers, covering entire local supply chains, along with additional proprietary data from its FMCG partners, such as sales and payment terms for wholesalers. The company employs predictive ML models to assess creditworthiness, create personalised product packages offered on consignment and recommends financing terms for wholesalers and retailers. The ML models are also designed to work with limited or noisy data when entering a new territory, relying on transaction histories, geolocation and limited behavioural signals.

The aggregation of granular sales and order data across neighbourhoods through the &frnds platform allows partner FMCG brands to launch hyperlocal promotions and track ROI at a micro-market level.

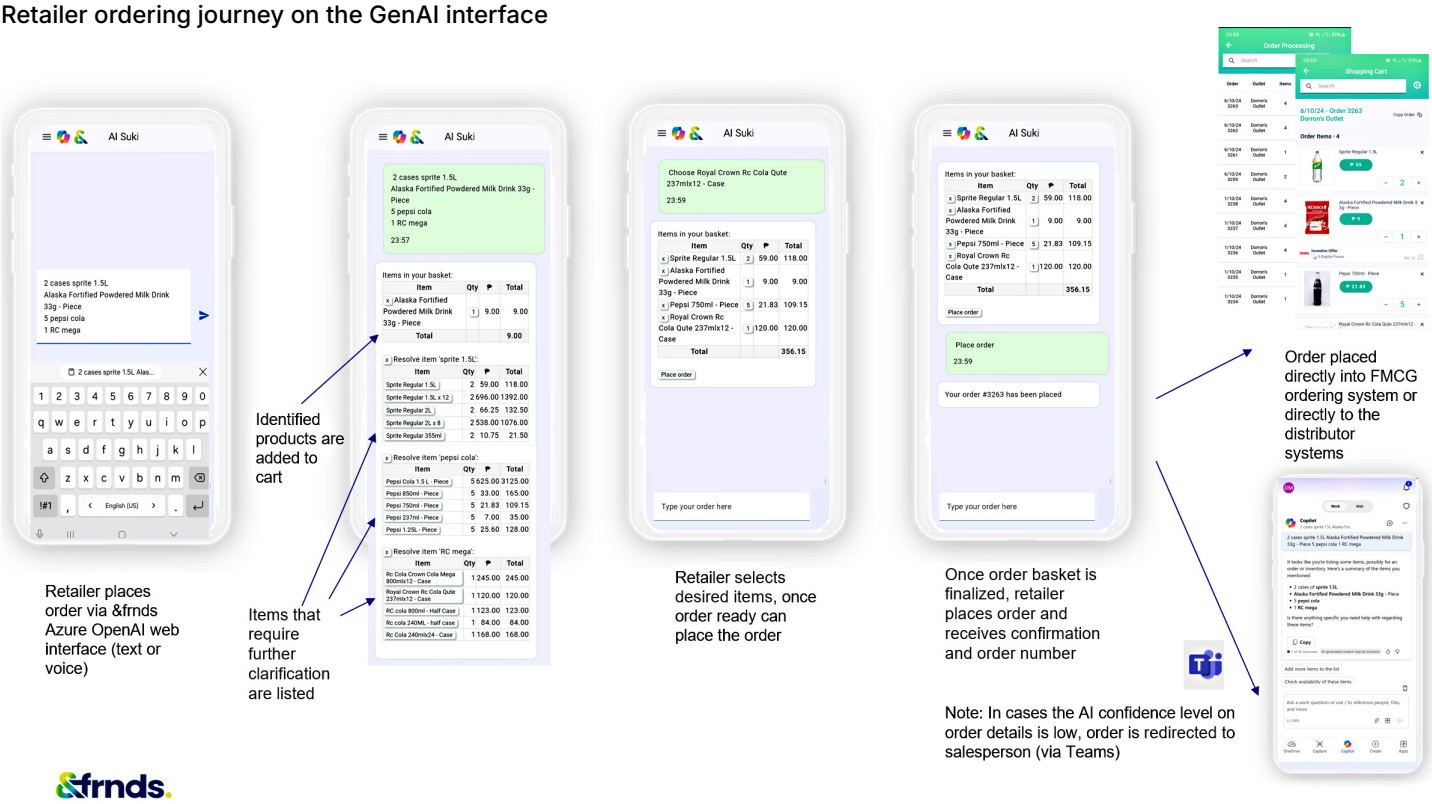
Leveraging familiar interfaces through GenAI

Although &frnds initially developed a traditional mobile app for SMEs, extensive testing across multiple countries revealed low adoption and usage rates, even when incentives were offered. Substantially increasing incentives led to commerce managers and FMCG sales representatives installing the app on store owners' phones and placing orders on behalf of the retailers, thus misusing &frnds' sales resources and failing to generate genuine user engagement.

These findings were validated through user interviews and surveys, which showed similar behavioural patterns across other digital platforms in the sector. The results revealed a critical insight: most SMEs in emerging markets do not rely on mobile apps for business operations and prefer chat-based interfaces that are already familiar to them.

Recognising these behavioural dynamics, the company introduced a GenAI-powered web interface that mirrors familiar messaging experiences, allowing microretailers to place orders conversationally rather than through a traditional order management system. &frnds plans to extend this technology to a broader range of SMEs. Retailers may place orders using either text or voice, according to their

Retailer ordering journey on the GenAI interface



Source: &frnds

preference. The conversational GenAI system evaluates the input and may pose additional clarifying questions to ensure the order is accurate before forwarding the information to the commerce manager for verification or directly to the wholesaler for fulfilment.

This solution particularly benefits women managing small retail stores, as they are able to place digital orders conveniently through a conversational interface. This functionality eliminates the need to visit wholesalers in person, saving time and preventing business disruptions. It also provides access to exclusive promotions and tailored trade finance packages, helping women entrepreneurs better manage and grow their businesses.

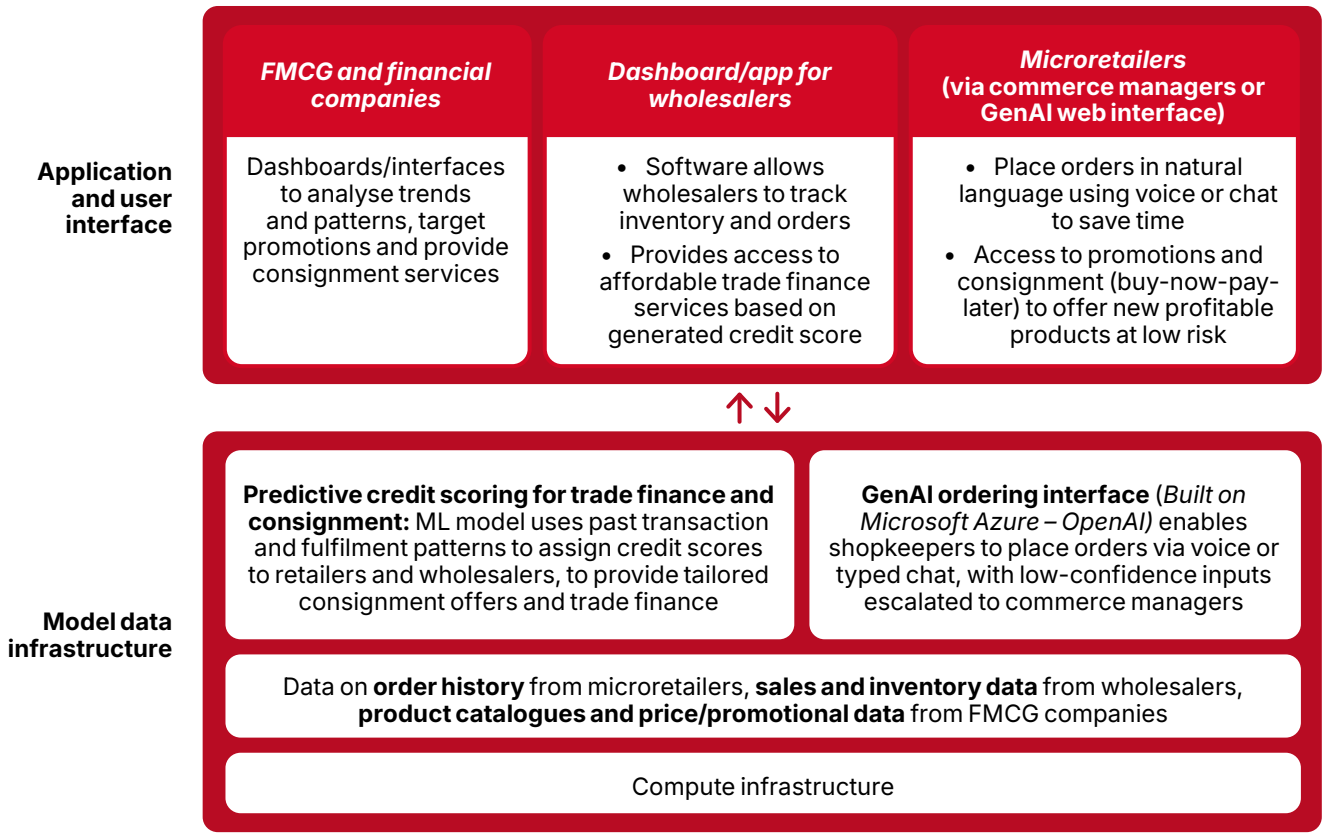
By using GenAI to increase the digital proficiency of store owners, &frnds anticipates that women will not only adopt digital ordering, but also use other digital tools and services offered for their business, such as payments, financial services, inventory management, record keeping, bookkeeping and access to information, which will further expand their capabilities and increase their profits.

Monitoring data has indicated that approximately 50% of users continued using the GenAI interface after their first trial. Follow-up surveys and interviews revealed that users valued the familiarity, time efficiency and convenience of being able to place orders without leaving their stores.

Technology profile

Type of AI:	Predictive AI, GenAI
Type of technology used:	ML, predictive analytics, NLP
Main users:	Microretailers, SMEs, wholesalers, distributors and FMCG companies
Delivery channels:	Mobile app, web interface and dashboards
Technology partners:	Microsoft, Open AI

Figure 46: &frnds AI architecture and data flow



Source: GSMA (2025)

Business model

&frnds operates a multi-vertical, asset-light business model, generating revenues from commerce and trade finance. The company partners with local wholesalers to create a network of regional shared warehouses, enabling it to run a zero-CapEx operation. &frnds drives digitalisation by placing commerce managers with partner wholesalers. These commerce managers visit microretailers to collect orders using the &frnds platform, creating a digital record of each transaction while the wholesalers handle fulfilment using motorcycles and tricycles, delivering either on the same day or within 24 hours.

A single commerce manager typically oversees around 250 microretailers with a service area of 5–10 km in cities and 10–20 km in semi-rural regions. Wholesalers handle order fulfilment.

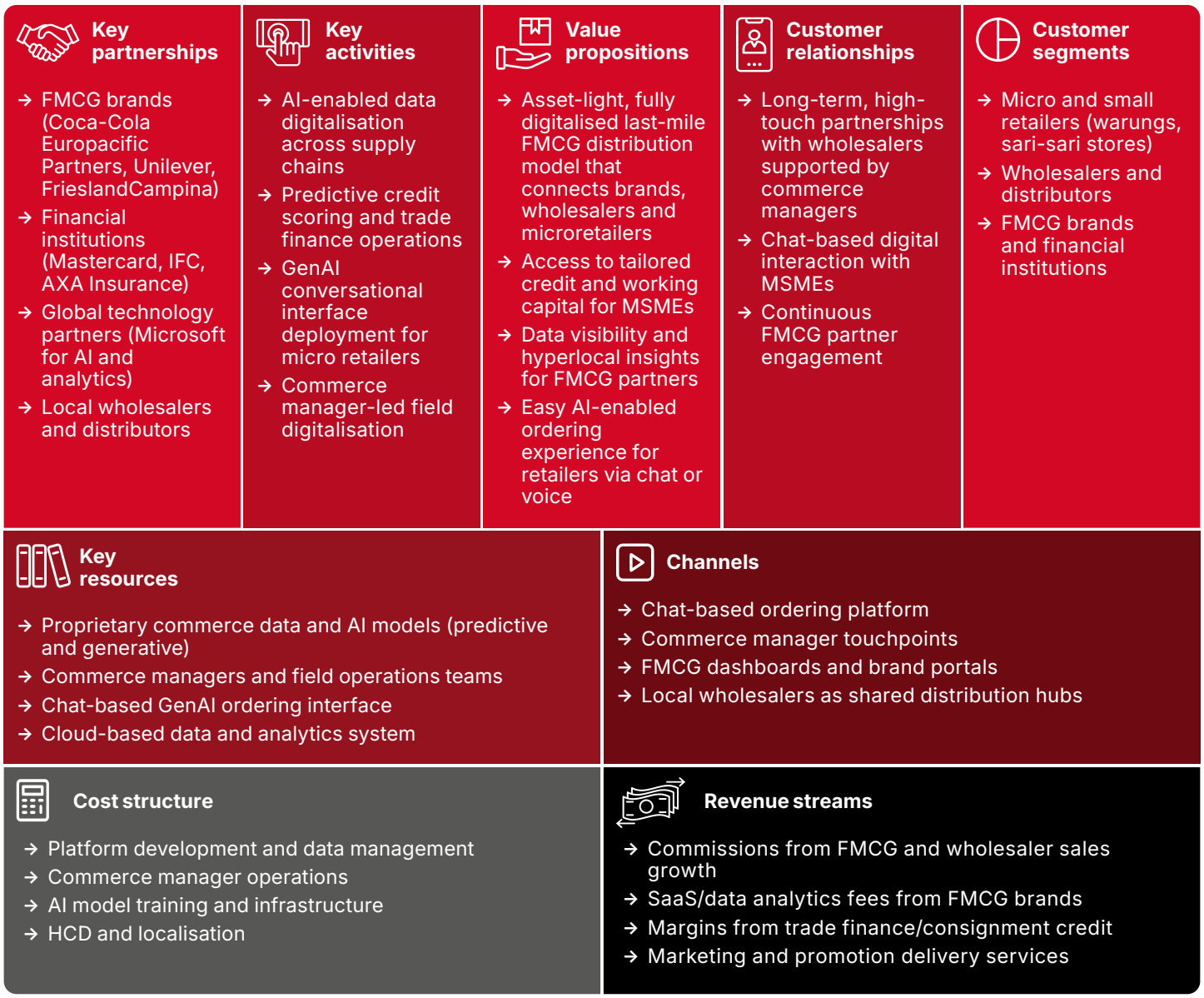
The commerce managers are a critical human element in &frnds' business model as digital-only retail optimisation business models have failed to gain and retain traction. This real-time, field-driven data model enables a new layer of services, such as access to credit for wholesalers and microretailers, and brand engagement at the last mile for FMCG partners.

&frnds covers its expenses and generates profits from their commerce services, paid by FMCG partners and wholesalers. For trade finance, the margins are even higher as &frnds only needs to cover the incremental cost of providing the service in the form of personalised product package consignments. As the company has exclusive access to the commerce supply chain data, the ML-based credit scoring provides an added advantage in managing credit risk effectively.

This integrated approach allows for better stock planning and improved access to trade finance for wholesalers, offers FMCG companies a cost-effective channel to reach last-mile markets and allows the company to cover fixed costs and scale profitably, avoiding traditional high-CapEx investments in inventory or infrastructure. This dual-sided value proposition makes the model financially viable while maintaining an asset-light structure that requires no warehousing or logistics ownership.

The layered revenue streams from commerce and finance mutually reinforce each other, enabling rapid credit model evolution and continuous platform improvements based on real-time data.

Figure 47: &frnds business model canvas



Source: GSMA (2025)

Impact and results

&frnds is helping to integrate those who have been excluded from the formal economy. By unlocking capital for small retailers and enabling more predictable supply chains, it boosts local economic resilience, particularly for women-led stores. It also improves efficiencies for FMCG brands by reducing leakage, enhancing stock targeting and generating insights from markets that were previously opaque.

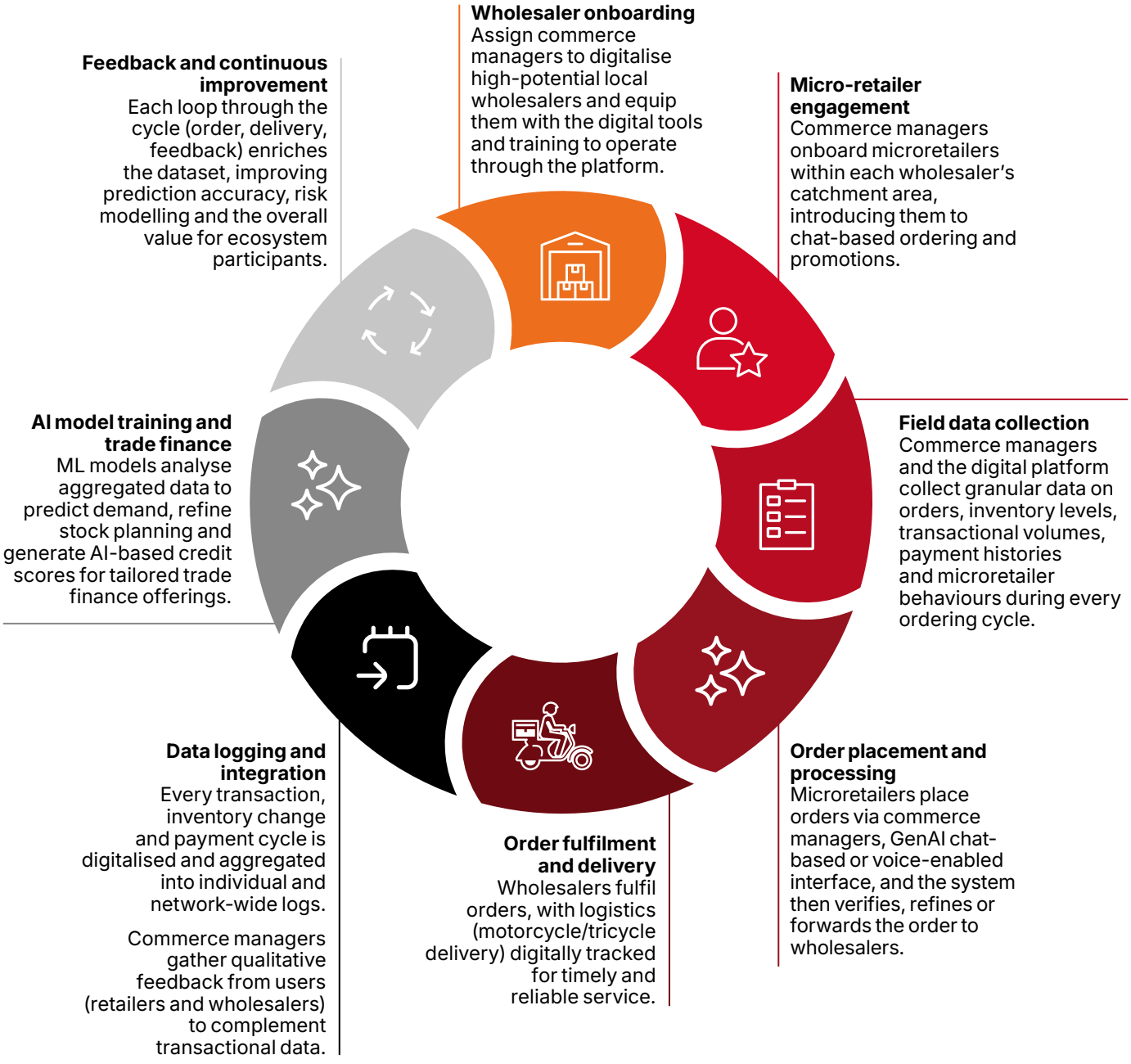
By enabling low-cost digitalisation of highly fragmented supply chains, &frnds unlocks operational visibility for brands and access to working capital for wholesalers and informal stores. Its predictive AI models support dynamic risk scoring and trade financing based on order histories, even where formal credit data is unavailable. This allows wholesalers to access consignments and finance without traditional underwriting processes, while FMCG brands benefit from increased control over pricing, stock movement and campaign performance. For microretailers, the model reduces stockouts and offers easier, trust-based ordering.

Micro and small retailers benefit from direct promotions offered by FMCG companies, as well as access to trade finance services such as consignment. These promotions can provide savings of up to 5–15% for small retailers. At present, many retailers lack access to such incentives because FMCG companies do not maintain direct relationships with them, largely due to the prohibitive cost of establishing these connections.

The consignment service mitigates the risk associated with purchasing unfamiliar products by enabling retailers to expand their offerings without committing upfront capital, thereby reducing inventory risk. Participation in such programmes also builds credit ratings, which can facilitate access to loans and other financial services. Additionally, the support of a commerce manager and the use of the GenAI ordering system allows retailers to place orders remotely without needing to close their stores or visit wholesalers in person, resulting in substantial time savings.

Wholesalers also experience considerable and immediate growth due to support from &frnds' dedicated commerce manager. After three to four months, once sufficient transactional data has been collected, they receive an &frnds credit score, making them eligible for the company's suite of trade finance services.

Figure 48: &frnds user journey



Source: Author's analysis

&frnds has observed that all users are increasingly adopting digital tools, gaining access to their own data and establishing digital footprints that open new business opportunities. While wholesalers tend to adapt more rapidly than small retailers, the introduction of the GenAI ordering system is anticipated to accelerate digital adoption among small retailers as well.

Challenges and future outlook

&frnds faces several challenges as it scales its hybrid technology-human resource model across diverse markets. Maintaining data accuracy, ensuring consistent service quality and expanding credit access amid evolving regulatory environments are ongoing priorities for the company.

A critical factor in the company's model is the identification of the right wholesale partners. The success of each hub depends heavily on the wholesaler's location and the density of microretailers in its serviceable area, which directly influences order volumes. Additionally, the commerce managers &frnds employs add to the operating costs, particularly in the early stages, until the order volumes reach a level that offsets the human resource cost of the commerce manager.

To support these scaling efforts, the company raised a $12 million late-stage venture capital (VC) round in July 2023,[189] with part of the funding directed toward strengthening human resource capacity and sustaining operational expansion.

&frnds is strengthening its AI capabilities to move beyond order management to a broader suite of digital business tools for micro-enterprises. Through HCD and continuous learning from local data, &frnds tailors its digital and AI-driven tools to meet the specific needs of small businesses and store owners, particularly women-led enterprises. Planned enhancements include advanced product recommendation engines, GenAI-powered financial management, payment integration and business advisory features aimed at further automating operations and empowering small retailers.

Drawing on its extensive experience and data from Southeast Asia, &frnds is now expanding into African markets. The company is offering services in Kenya, South Africa, Zimbabwe, Uganda, Rwanda and Côte d'Ivoire, with additional launches planned. By running pilots and forming partnerships, &frnds tailors its hybrid model to suit the varied informal retail ecosystems found across these countries. The company's sectoral focus currently includes agribusinesses and food supply chains, where it is leveraging its technology platform to enhance efficiency, transparency and inclusion. Sustained investment in AI-driven personalisation, trade finance and ecosystem partnerships is needed to position &frnds to deepen its impact and advance inclusive economic growth across emerging markets.

189. Pitchbook, "&frnds Investors".

SPOTLIGHT 6: GENAI FUND IS SHAPING SOUTHEAST ASIA'S AI LANDSCAPE

Noticing that many Southeast Asian investors had limited familiarity with AI, a group of entrepreneurs and technologists established the GenAI Fund, which invests in early-stage, AI-first startups across the region.

Beyond capital and hands-on support, GenAI Fund plays an active role in shaping the regional AI ecosystem. For instance, their use case database[190] showcases real-world, high-impact AI use cases, while their ASEAN GenAI startup report[191] provides insights into the region's AI ecosystem and trends. In addition to their work with startups, the Fund collaborates with governments and big tech players to advance AI adoption and address the fundamental AI challenges facing Southeast Asian countries.

As most startups in the region work on B2B models, selling to enterprises, they also created a flagship programme to drive adoption: the Gen AI Open Innovation platform. The platform connects supply (startups) with demand (enterprises), matching real-world needs with relevant AI solutions. The platform includes startups outside of GenAI Fund's investment portfolio, highlighting their broader commitment to strengthening AI innovation across Southeast Asia.

190. GenAI Fund

191. GenAI Fund. (2024). *ASEAN GenAI Startup Report 2024*.

Case study: **SmartTerra**

Context

Around half the world's population, approximately 4 billion people, experience high water stress for at least one month every year,[192] and an estimated 1.8 billion could face absolute water scarcity by the end of 2025.[193] Water utilities in LMICs face a persistent and systemic challenge of non-revenue water (NRW).[194] In many emerging economies, NRW rates reach alarming levels, typically ranging between 25% and 50% of treated water volumes. This high rate of water loss arises from a combination of physical losses, such as leaks, bursts, theft, pipe deterioration and pressure fluctuations. Because of these losses, utilities in LMICs incur substantial financial stress as they pay the full costs of treatment, pumping and distribution, yet only recover revenue on a fraction of the water output.

Despite the magnitude of the challenge, many utilities lack the technological, financial and organisational capacity to address it effectively. Sensor coverage is costly and often sparse or absent, network maps may be outdated or inaccurate, data is fragmented or siloed and classic leak detection is labour-intensive and reactive. As a result, they lack visibility into where losses occur or how to prioritise interventions. These inefficiencies prevent utilities from expanding their networks and disproportionately affect lower-income households, which experience more frequent water shortages and are less able to afford alternatives like private tankers.

About SmartTerra

SmartTerra is a tech startup based in India that provides utilities with AI-enabled tools to detect water losses and plan more efficient maintenance. The company offers utilities AI-enabled tools that analyse data from multiple sources, including IoT devices, flow meters and network maps, to simulate flow and pressure dynamics across entire networks, detecting leaks, predicting failures and optimising operations. The company's AI-enabled tools equip utilities to make data-informed decisions that enhance service reliability, conserve water and reduce the carbon footprint of water systems.

Organisation profile

Year founded: 2020

Business type: For profit

Stage: Early commercial/scaling

Funding: Grants and corporate partnerships

Team size: About 25

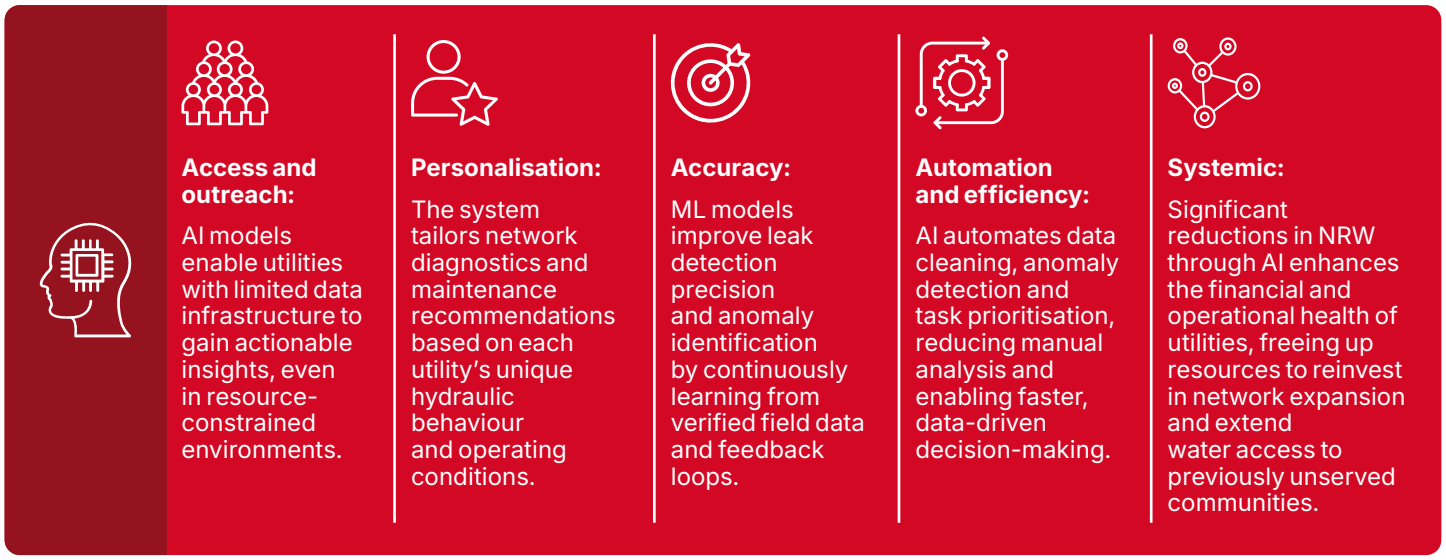
Geographies: India, Singapore, Philippines, Indonesia, Australia and Oman

192. World Economic Forum and World Resources Institute. (25 August 2023). "25 countries face extremely high water stress, study finds".

193. FAO. (n.d.). "Water scarcity".

194. Non-revenue water (NRW) is defined as the volume of water that is produced or enters the water distribution system but does not generate revenue because it is lost, not billed or not paid by customers for other reasons.

Figure 49: The value AI adds to SmartTerra



Source: GSMA (2025)

AI solution and architecture

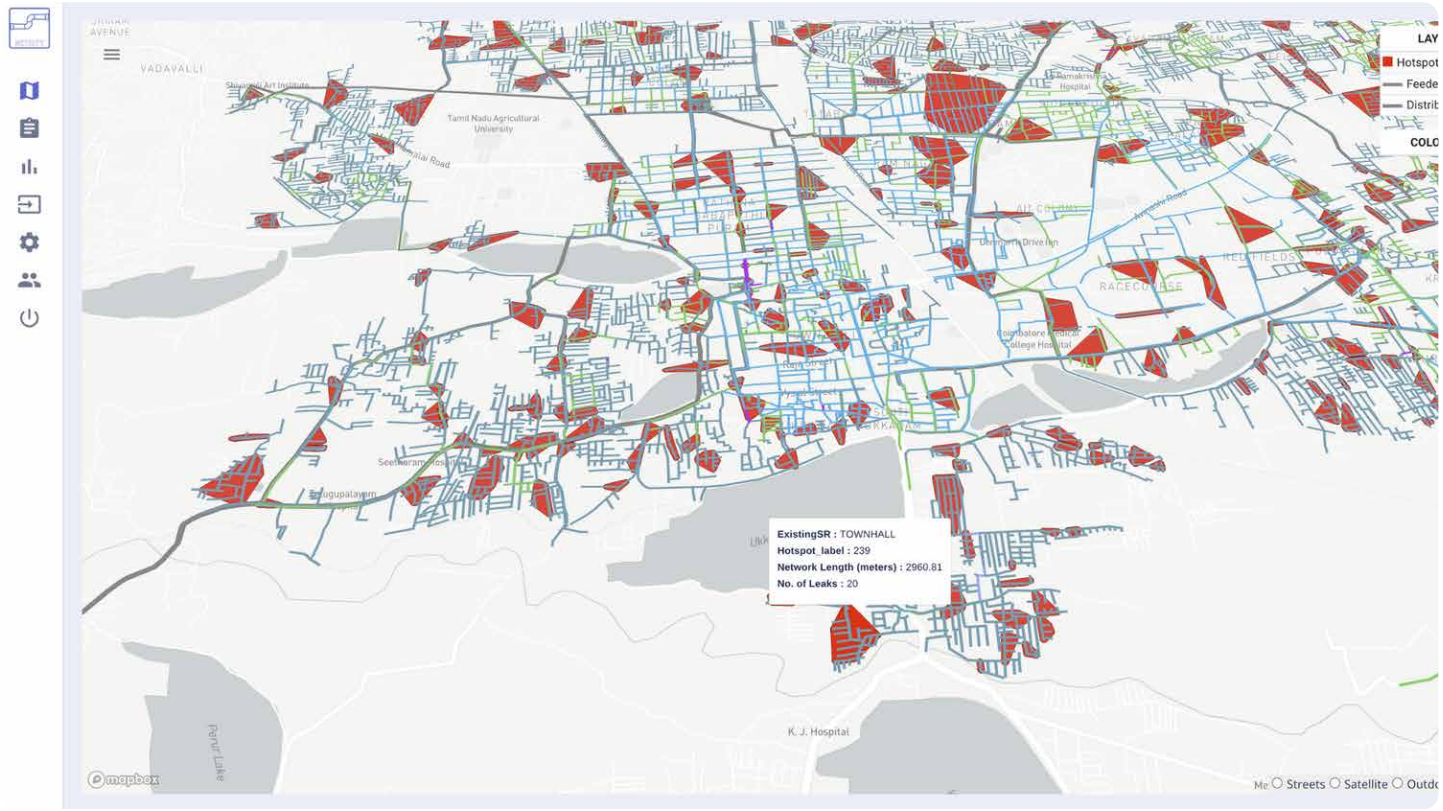
SmartTerra uses a combination of geospatial AI and automated hydraulic calibration to build a "digital twin"[195] of each utility's water network in its platform Netcity Condition, simulating how flow and pressure should behave under different conditions. This simulation is powered by diverse data inputs, ranging from IoT sensor readings, water consumption data from households or commercial users, network maps and pipe attributes, maintenance and repair logs and environmental data. Its system integrates these data inputs to detect patterns and anomalies that indicate leaks, blockages or inefficiencies.

In contrast to international utility management service providers that rely on continuous data ingestion from a permanent sensor fleet, SmartTerra's ML models are purpose-built to operate effectively under data scarcity, reflecting the operational realities of utilities in LMICs that often lack continuous water supply and comprehensive sensor coverage. The models are robust enough for intermittent system operation, enabling accurate analysis even with fragmented data inputs. Field teams deploy temporary sensors for short periods (typically two to three days) to collect key flow and pressure data before relocating them to another section of the network. This "lift-and-shift" data collection approach provides broad network coverage in a cost-effective and adaptable manner, making the system viable for resource-constrained environments.

A central dashboard displays high-risk network segments for utilities and auto-generates tasks for field engineers on the mobile app. As field engineers complete tasks and validate these insights in the field, the feedback loops back into the AI model, enhancing its accuracy over time while improving the quality of data for the utilities. SmartTerra is also developing a GenAI chatbot to allow utility staff, including non-technical field workers, to query the system and access recommendations more intuitively.

195. A digital twin is a virtual representation of an object or system that spans its life cycle, is updated from real-time data and uses simulation, machine learning and reasoning to aid decision-making. IBM.

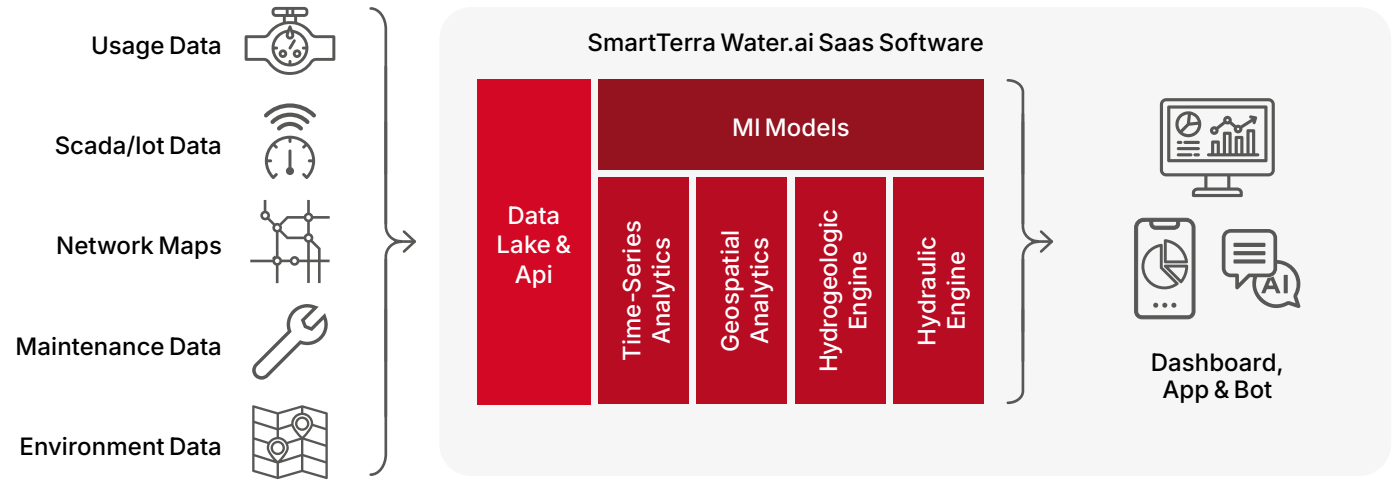
NetCity by SmartTerra
(Visualisation of historical maintenance, leak activities along with network age, operational and environmental stresses)



Source: SmartTerra

Figure 50: SmartTerra AI architecture and data flow

SmartTerra is developing an ML-powered analytics software, Water.AI, to enable water and wastewater utilities to effectively unify and analyse their existing data.



Source: SmartTerra

Technology profile	
Type of AI:	Predictive AI, GenAI (future)
Type of technology used:	ML, deep learning, digital twin modelling, predictive analytics
Main users:	Utility companies, operations managers, field engineers
Delivery channels:	Web-based dashboard and mobile app

Business model

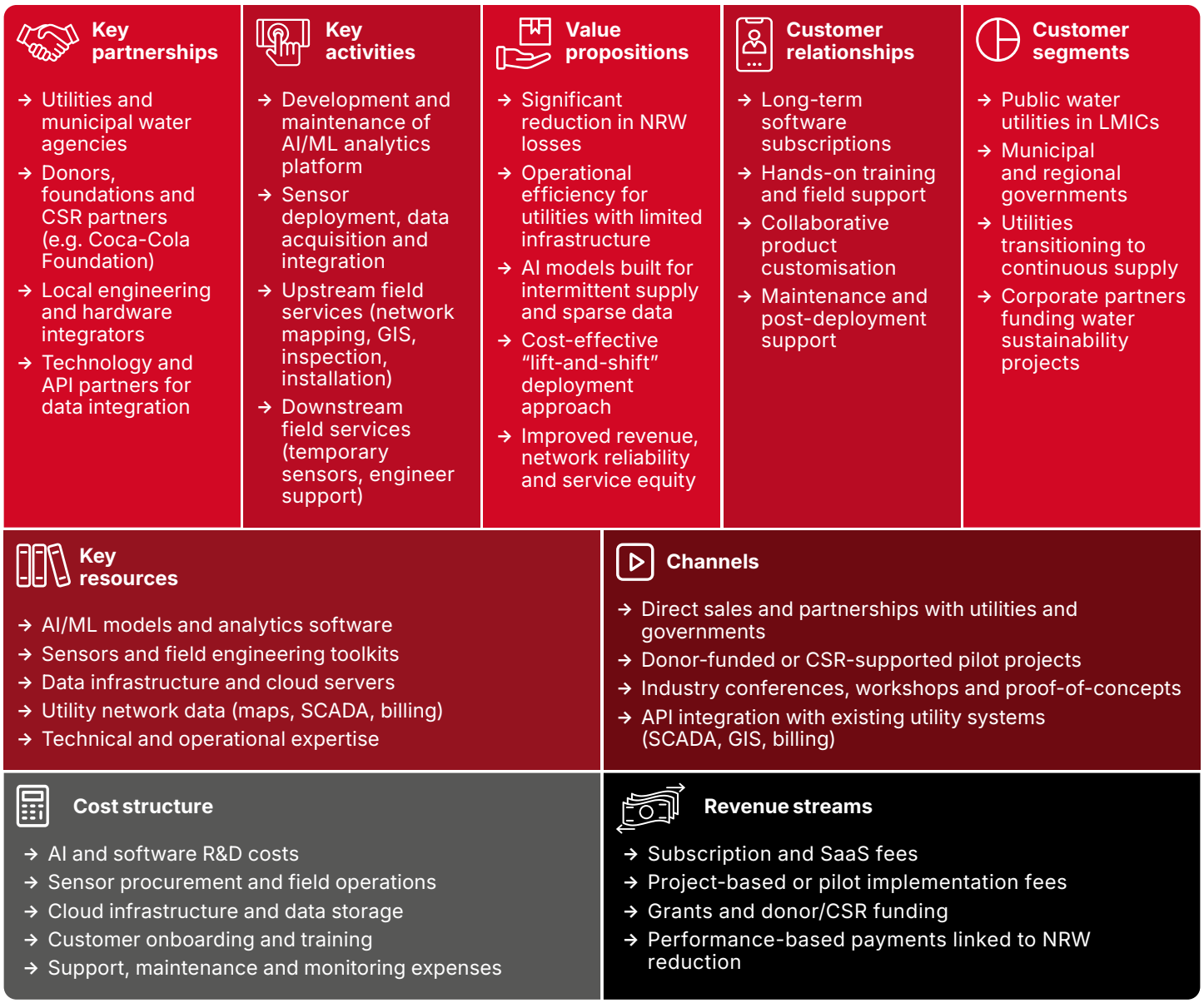
SmartTerra generates revenue primarily through B2B software contracts with utilities and local government partners. It also collaborates with donors and corporate funders for pilot deployments, particularly in early-stage markets. The company complements its core software offering with a suite of field services in India, both upstream and downstream, to support data acquisition and operational implementation. Services include network map clean-up, in-pipe probe inspections to assess pipe conditions, GIS surveys of customer connections, installation of electromagnetic flow meters (EMFs) and pressure sensors, and API integrations to enable reliable data input, ensuring that utilities can implement and maintain monitoring systems effectively.

SmartTerra is also exploring blended financing models, such as CSR funds and Volumetric Water Benefit Accounting (VWBA)[196] frameworks, which enable companies to finance water efficiency or replenishment projects as part of their sustainability commitments. A practical example of this approach is the pilot funded by The Coca-Cola Foundation[197] through its Sustainable Access Solution Fund, which supports the deployment of SmartTerra's AI-powered analytics to reduce water losses in selected Indonesian utilities. In this model, SmartTerra receives grant and technical support to implement leak-reduction technologies, while Coca-Cola helps de-risk adoption and expand access to reliable and efficient water systems.

196. Volumetric Water Benefit Accounting is a standardised, science-based methodology developed by the World Resources Institute (WRI) and partners to help companies and organisations implement and value water stewardship activities, such as watershed restoration, by providing a common framework to quantify the benefits of such initiatives. WRI.

197. The Coca-Cola Company. (20 March 2025). "Innovation in action: The Coca-Cola Foundation supports AI-powered technology pilot aimed at tackling water loss challenges in Indonesia".

Figure 51: SmartTerra business model canvas



Source: GSMA (2025)

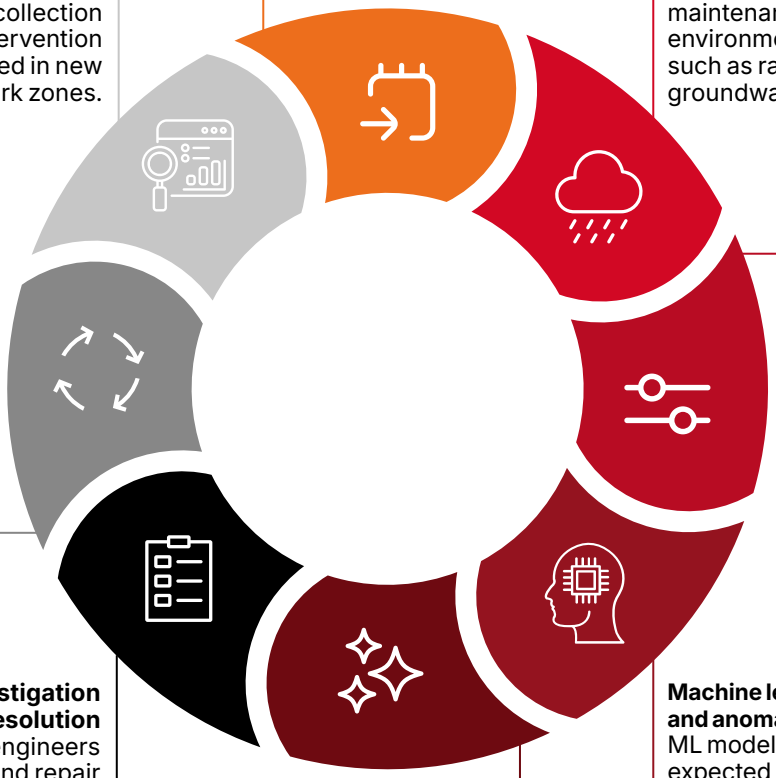
Impact and results

SmartTerra's AI-driven analytics platform has had a significant impact on the efficiency and sustainability of water utilities. Utilities have reported measurable reductions in NRW, even in systems with intermittent supply, in as little as three months. The platform achieves up to 75% accuracy in locating leaks and illegal connections, and up to 80% accuracy in detecting abnormal meters and connections, thereby improving revenue recovery and operational efficiency.

For instance, in one of its projects in Coimbatore, India, with the water management company SUEZ,[198] SmartTerra reported 72% accuracy in predicting poor-condition pipes and 35% accuracy in predicting future leaks/bursts. It used datasets from 1,700 km of network serving more than 250,000 connections and three years of maintenance history and environmental stresses.

198. SUEZ in India

Figure 52: SmartTerra user journey



Data collection and field deployment
Field teams install temporary pressure and flow sensors, conduct GIS surveys and network map clean-up to establish accurate baseline data on the system's physical and operational conditions.

Data integration and ingestion
Sensor data (flow, pressure and velocity) is integrated with usage and billing records, maintenance logs and environmental datasets such as rainfall and groundwater levels.

Data cleaning and validation
The platform automatically performs data quality checks, filtering out noise, inconsistencies and gaps. Calibration processes are used to synchronise readings and reconcile variations caused by intermittent supply or irregular telemetry.

Machine learning analysis and anomaly detection
ML models simulate expected hydraulic performance across the network, comparing predicted and actual flow and pressure values. The system identifies anomalies indicative of leaks, bursts or meter inaccuracies and prioritises network zones with the highest probability of losses.

Decision support and task generation
Insights from the ML analysis are displayed on a central dashboard. The platform automatically generates and assigns field tasks, ranked by urgency and potential impact.

Field investigation and resolution
Field engineers investigate and repair flagged issues, validate leaks, conduct repairs or meter replacements and record observations through the SmartTerra mobile app. Each completed task is time-stamped and geotagged, providing verified ground truth data.

Feedback and model retraining
Post-repair data and field logs are fed back into the platform, enabling continuous learning. The ML models are retrained using this updated information, improving future anomaly detection and leak prediction accuracy.

Monitoring, reporting and expansion
Utility managers monitor ongoing performance via SmartTerra's analytics dashboard, tracking reductions in NRW, improvements in pressure stability and recovery of water revenue. Data collection and intervention cycle is repeated in new network zones.

Source: GSMA (2025)

SmartTerra Web Dashboard – project with SUEZ

Modeling the network, city and weather.
Dynamically predicting pipe condition & future leaks

Datasets

- Network attributes +
- Environmental stresses +
- Maintenance history (3 years) +
- Operational stresses

Outputs

- Classifier model of network, leaks and stresses
- Pipe scores: Likelihood of leakage, failure
- Consequence of failure

Field Validation

- 72% accuracy in predicting poor-condition pipes
- 35% of future leaks predicted in the top 10% of network length

Coimbatore: 1,757 km network serving 1M people

Source: SmartTerra

By optimising network performance, SmartTerra also contributes to reducing energy consumption and associated carbon emissions, aligning with global sustainability goals.

Challenges and future outlook

The water sector is widely recognised as one of the more complex and under-prioritised areas of climate action, even though water crises frequently rank among the highest-impact global risks in annual assessments by the World Economic Forum.[199] While sectors such as energy and transport have attracted investments and innovations, water systems lag.

One of the main challenges is dealing with unreliable and noisy data, especially in regions like South Asia where infrastructure and data quality can be inconsistent. SmartTerra's software relies heavily on AI and ML to clean and process data, integrating information from IoT devices and network monitoring systems, and the lack of reliable data leads to higher compute and processing costs.

Ageing infrastructure and rapid urbanisation are compounding underlying vulnerabilities. Since the impacts of climate change tend to manifest most directly as water stress and scarcity, extreme floods and prolonged droughts, effective water management is a vital, although overlooked, frontier in climate resilience.

Operating in the urban water management sector presents its own challenges. Utilities in LMICs face limited budgets, fragmented digital infrastructure and resistance to adopting new technologies. Many still rely on manual data collection, making digitalisation a gradual process.

SmartTerra plans to expand beyond its current focus on piped water to include stormwater, wastewater and industrial water management, leveraging AI and data integration to improve environmental sustainability. The development of its GenAI interface will further simplify field operations, enabling engineers to access real-time network insights and recommendations in local languages and natural formats.

199. World Economic Forum. (2025). *Global Risks Report 2025*.

The company is also actively exploring geographic expansion beyond its current operations in India, the Philippines and Indonesia, targeting new markets in Southeast Asia, Africa, the Middle East and even the Global North as part of its strategy to derisk market exposure and diversify its customer base. When assessing potential markets for expansion, SmartTerra considers several preconditions for the effective deployment and adoption of its technology. These include the sufficient willingness and technical capacity of local utilities to adopt digital solutions and improve digital data collection. A basic level of digital infrastructure, including reliable metering systems capable of capturing consumption data accurately and basic internet connectivity to transmit this data to a central database, are necessary for the implementation of SmartTerra's solutions. Additionally, early-stage markets require flexible revenue models, such as a combination of direct sales, grant-supported pilot programmes and collaborations with corporations focused on water replenishment or sustainability, since many public utilities have limited financial resources.

The company's strategy is to maintain its technology as modular and adaptable, supporting integration with a variety of data sources and new foundational technologies as applicable. As the digitalisation of utilities accelerates, SmartTerra and other AI-first, impact-driven technology organisations can become key enablers of climate-smart urban infrastructure, helping cities reduce water loss, cut emissions and adapt to the growing challenges of water stress.

Case study: **Husk Power Systems**

Context

More than 730 million people globally still lack access to reliable electricity,[200] with rural communities in Sub-Saharan Africa and South Asia disproportionately affected. In these regions, rural communities face unreliable supply and frequent outages, negatively affecting local enterprises and limiting socio-economic growth.

Extending the national grid to these regions is often prohibitively expensive due to low population density and high infrastructure costs. In the absence of grid access, diesel generators are widely used but are costly, polluting and unsustainable. The World Bank estimates generator spending across developing economies at $30–$50 billion annually, with fuel costs alone averaging $0.30 per kWh, double the average cost of grid electricity.[201]

Off-grid electrification models have emerged as an alternative but face persistent challenges: managing decentralised systems in real time, recovering payments efficiently and maintaining financial viability in settings with unpredictable demand. These barriers have limited the scalability and long-term impact of clean energy solutions for rural electrification.

About Husk Power Systems

Husk Power Systems is a US-based clean energy company, with major operations in India and Nigeria. Founded in 2008, the company initially deployed biomass gasification technology using rice husks to provide electricity to rural communities. However, this technology delivered limited hours of electricity (7–8 hours) and was expensive and difficult to manage, prompting a pivot to solar and battery technology in around 2015. Today, Husk builds, owns and operates low-cost hybrid mini-grids that combine solar, battery storage and Internet of Things (IoT) infrastructure to deliver reliable electricity to rural households, MSMEs and small industries, distributed over a 3–5 km radius.

Organisation profile

Year founded: 2008

Business type: For profit

Stage: Growth

Funding: Series D round closed in 2023 (equity and debt financing)

Team size: About 1,200 employees (approx. 90% field employees)

Geographies: Nigeria, India

200. Cozzi, L. et al. (9 October 2025). "Access to electricity stagnates, leaving globally 730 million in the dark". IEA.

201. International Finance Corporation. (2019). *The Dirty Footprint of the Broken Grid*.

Figure 53: The value AI adds to Husk Power Systems

Source: GSMA (2025)

AI solution and architecture

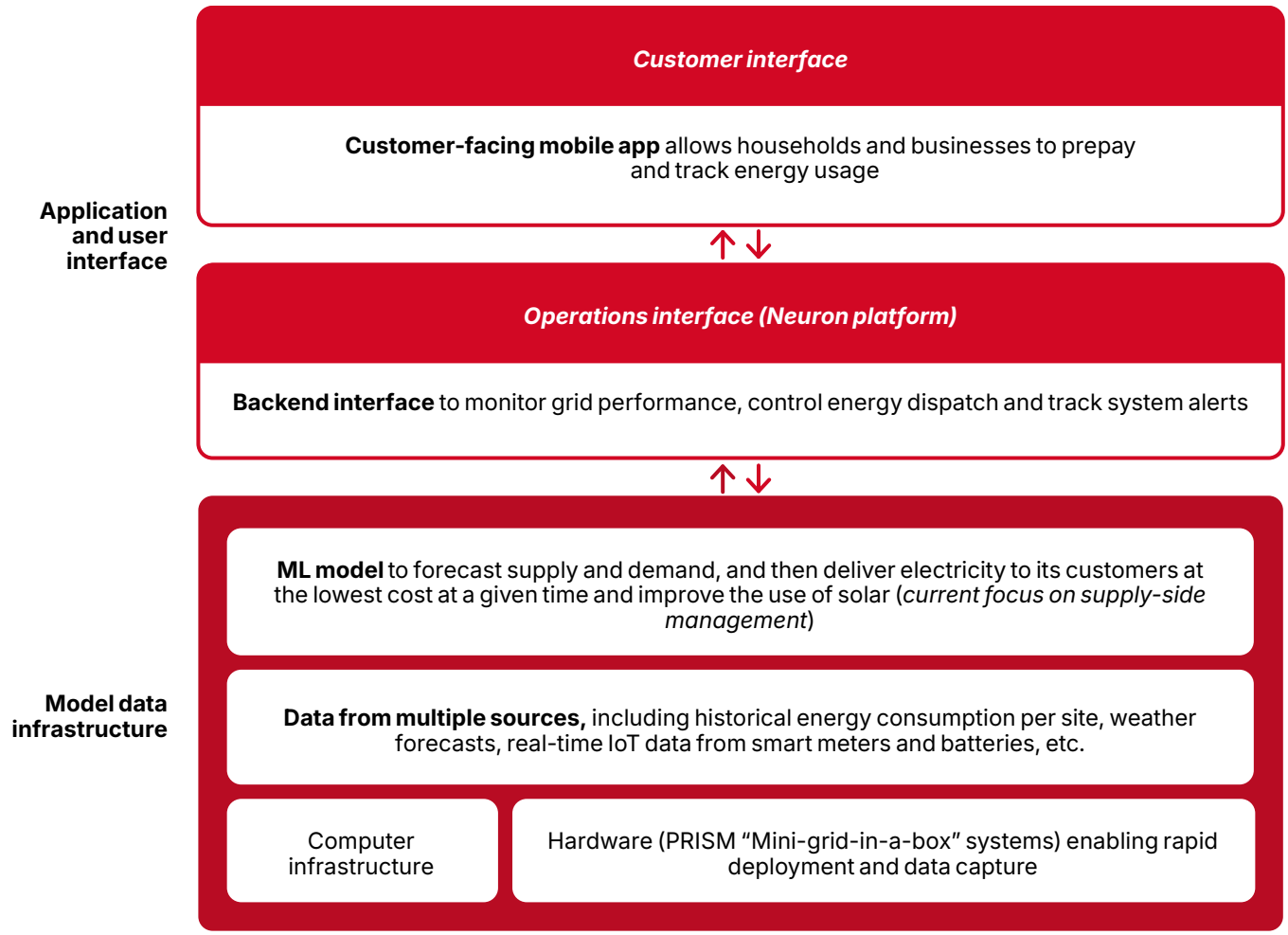
Husk uses AI to scale its operations and make clean energy accessible and affordable for people in rural communities, applying it across various aspects of its business, from managing electricity supply and demand to enhancing customer engagement.

A primary application of AI at Husk is predictive analytics for load forecasting. By analysing historical consumption patterns, weather data, real-time inputs from smart meters and battery systems and load profiles of individual sites, the company's AI-powered algorithms can accurately forecast supply and demand. Husk's AI models optimise energy use in its hybrid mini-grids by forecasting demand and managing the dispatch of solar, battery and diesel power in real time, ensuring reliable supply at the lowest operational cost. The system automates key operational decisions such as load balancing and generator dispatch, and flags issues that may need maintenance intervention. Husk's approach supports consistent grid performance across dispersed sites while improving solar energy use, reducing operational costs and minimising dependence on diesel.

Husk has developed an AI algorithm to de-risk its investments and guide site selection for new mini-grids. Before investing capital to build, own and operate a system, the company uses this complex scoring methodology, leveraging AI to evaluate potential communities. The AI algorithm integrates a variety of inputs, including primary data gathered through ground-truthing,[202] secondary macroeconomic information and GIS technology.[203] Based on extensive historical performance data, if a community scores above a certain threshold, Husk has 90% certainty that the site will become profitable within a predetermined time frame, ensuring that every new mini-grid is strategically placed for maximum viability.

202. Ground truth data is verified real-world data, considered the gold standard for training, validating and testing AI models. Krantz, T. and Jonker, A. (n.d.). "What is ground truth?" *IBM Think*.
203. Jonker, A. (n.d.). "What is a geographic information system (GIS)?" *IBM Think*.

Figure 54: Husk Power Systems AI solution and architecture



Source: GSMA (2025)

Technology profile

Type of AI:	Predictive AI
Type of technology used:	ML, predictive analytics
Main users:	MSMEs, households, commercial and industrial customers
Delivery channels:	Mobile app, web platform

Business model

Husk runs an integrated business model, building, owning and operating its entire energy infrastructure, combining electricity generation and distribution with affiliated services to improve people's quality of life and support local economic activity. At its core is a pay-as-you-go (PAYG) service model that uses IoT-enabled smart meters for all connections. Customers manage their energy consumption and make payments through a consumer-facing mobile app. The system relies entirely on digital payments, with no cash options available. With customers paying upfront, Husk typically receives more than 90% of its payments within the first five days of the month, virtually eliminating the risk of default.

The company's customer base varies significantly by market. In India, where the primary challenge is the unreliability of the existing grid rather than a lack of access, more than 90% of Husk's customers are MSMEs that require a stable, high-quality power supply. In contrast, the customer mix in Nigeria is approximately 70% households and 30% businesses.

Beyond direct energy sales, Husk has developed several other revenue streams to drive growth. It leverages its building expertise to earn income from rooftop solar deployments for commercial and industrial (C&I) customers through turnkey or power purchase agreement (PPA) models. The company also operates an e-commerce platform for appliance sales and financing, providing credit for both household and productive use appliances to customers.

Additionally, Husk monetises the displacement of diesel fuel through the voluntary carbon market and is piloting value-added services, such as solar-powered agricultural processing (rice and spice milling), cold storage hubs and e-mobility solutions.

The company reached profitability in 2023, having reduced operational costs through AI and expanded its commercial offerings. The following year, the company reached the industry's fastest deployment rate by installing one mini-grid per day, aided by PRISM,[204] an innovative "energy-in-a-box" solution developed at the company's centre of excellence in India.

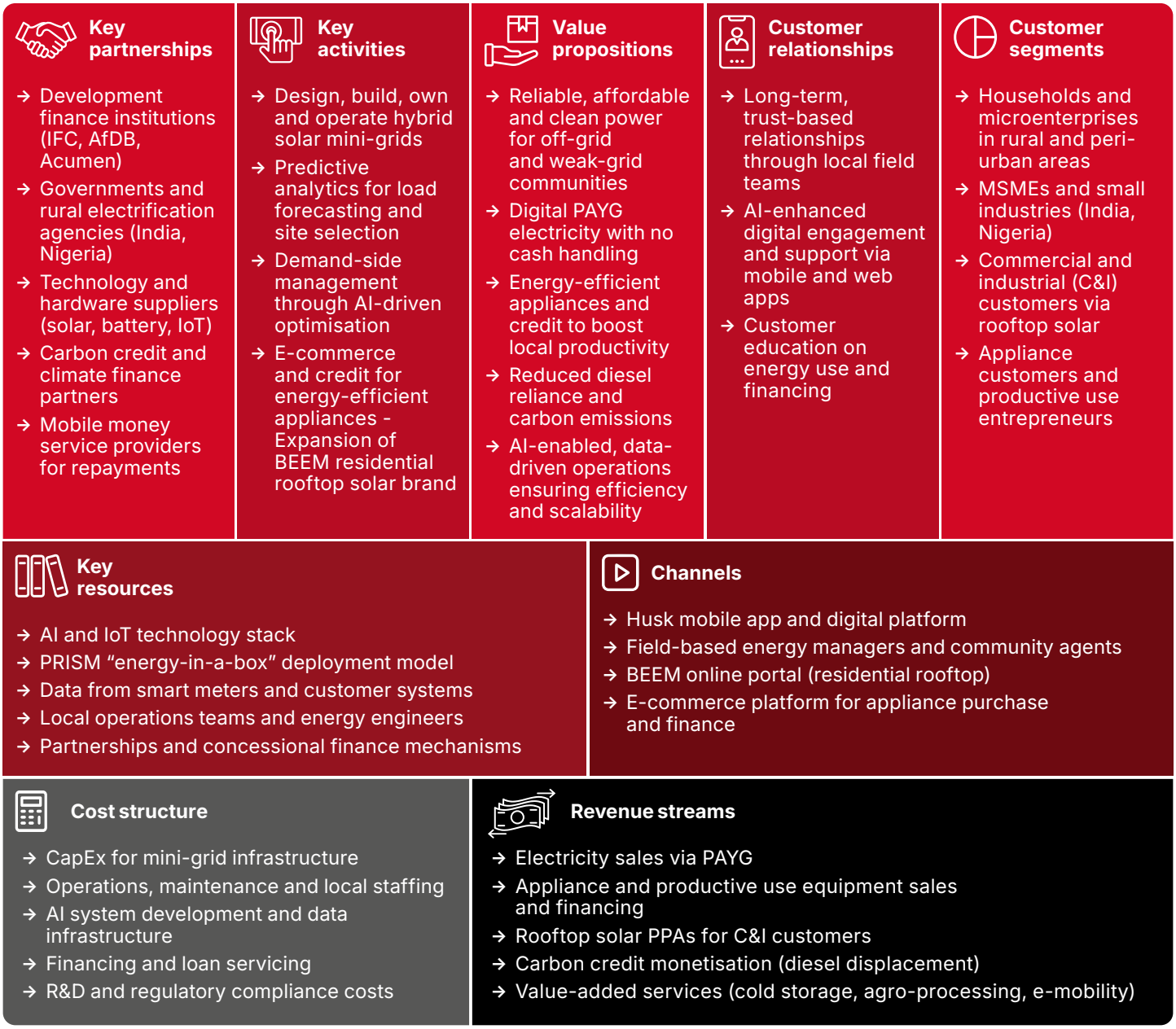
PRISM deployment

Source: Husk Power Systems

While it has closed a Series D investment round and accessed debt financing, Husk is actively seeking grant funding to de-risk future innovation and support continued R&D in AI and distributed energy management.

204. PRISM stands for Power Resilience and Intelligent System Management and is suitable for isolated and grid-interconnected mini-grids, captive and embedded C&I systems and emergency energy for climate resilience and displacement.

Figure 55: Husk Power Systems business model canvas



Source: GSMA (2025)

Impact and results

By embedding AI in its operations, Husk has been able to streamline service delivery, reduce operating costs and expand access to reliable electricity in hard-to-reach areas. Predictive AI models help optimise energy dispatch and reduce waste, enabling leaner staffing and more consistent performance across mini-grid sites. This automation is crucial for scale, as it is projected to reduce the workforce required for operations by more than 75%. The implementation of AI has already yielded significant results, including a 40% reduction in the use of backup diesel generators, a 20% increase in the use of solar energy and an extension of battery life spans by up to six months.[205]

Husk has doubled its operational capacity every year since 2023 and is the world's largest mini-grid company by number of sites. By early 2025, Husk Power Systems' mini-grids provided 20 megawatts (MW)[206] of distributed solar generation, serving more than 1.5 million

205. Deign, J. (10 January 2024). "Why Husk Power believes AI is key to electrifying rural communities". *Latitude Media*.

206. A megawatt (MW) is the standard unit used to measure electrical power in the International System of Units (SI). 1 MW is equivalent to 1 million watts or 1,000 kilowatts (kW). Carbon Collective.

people and more than 30,000 small businesses in over 400 communities.[207] The company is also offsetting approximately 15,000 tonnes of CO2 annually by eliminating an estimated 4,000 diesel generators across its entire portfolio.[208]

Husk's mini-grids support economic transformation for rural and peri-urban communities by offering reliable and affordable energy, enabling longer business hours, cold storage for perishable goods and the growth of micro and small enterprises such as milling, welding and carpentry. By pairing energy supply with credit-financed productive use appliances, the company helps entrepreneurs automate processes and increase output. For example, local carpenters who once made a handful of furniture items per month can now produce 10 times more through electrically powered machinery, procured from Husk through its asset finance facility.

Challenges and future outlook

Husk faces challenges expanding its AI mini-grid systems in Africa and Asia, including limited access to capital, unavailability of reliable data and lack of regulation for small power plants.

Financing and capital constraints

For a company like Husk that builds, owns and operates mini-grids, rural electrification remains highly capital-intensive as the company's operating model requires substantial upfront investment in equipment, infrastructure and local workforce mobilisation. While blended finance from the Canada-IFC Renewable Energy Program[209] and debt facility from the United Capital Infrastructure Fund (UCIF)[210] are supporting Husk's expansion in Nigeria, securing long-term concessional capital continues to be difficult, as most public funding is channelled through large international programmes with lengthy approval processes and high transaction costs, while private investors often lack familiarity with mini-grid revenue models.

Reliance on debt-heavy funding structures places new pressure on Husk's cashflows as, unlike equity, these facilities require regular repayments and interest servicing, straining liquidity in an already capital-intensive business model.

Availability of reliable data

A persistent challenge for Husk is the availability and reliability of data needed to identify and evaluate new sites. Accurate site selection depends on assessing multiple parameters, such as population density, consumer income levels, economic activity and seasonal energy demand. However, such datasets are rarely available in rural and low-income regions. In many cases, public statistics are outdated, lack sufficient spatial granularity or are inconsistent across administrative boundaries, resulting in uncertainty when forecasting consumption patterns and project profitability.

To address data gaps, Husk conducts on-the-ground surveys and energy use audits to establish realistic baselines for household and productive energy demand. While this ground truth data is critical to calibrating AI-based site selection algorithms, it is costly and labour-intensive to collect across dispersed and remote areas. Field teams must physically visit communities, map local assets and assess affordability, a process that can take months and significantly raise project preparation costs. These data limitations can lead to over- or undersizing of mini-grid systems, affecting return on investment and long-term operational viability.

Although Husk integrates geospatial analytics and satellite imagery to supplement traditional data collection, their predictive accuracy in dense or tree-covered rural areas remains imperfect. Consequently, Husk must constantly fine-tune its AI-based site scoring tool to learn from limited, noisy datasets while improving site viability predictions over time.

Regulatory fragmentation

Many LMICs still lack specific policies for mini-grids in their national electrification plans, which makes project planning and implementation difficult for private mini-grid developers. For instance, in India, Husk is required to fulfil the same procedural and compliance requirements as large utilities,

207. Husk Power Systems. (7 January 2025). "Husk electrifies 200 new communities in 12 months, doubling its fleet of solar minigrids and cementing global leadership position".
208. Glinska, G. (4 March 2025). "Husk Power Systems Eyes IPO and Aims to Provide Clean Energy to 100 Million". *The Darden Report*. University of Virginia.
209. IFC. (13 May 2025). "IFC and Canada Invest in Husk to Catalyze Solar-Powered Economic Growth in Rural Nigeria".
210. United Capital. (2025). "United Capital Infrastructure Fund (UCIF) and Husk Power Announce ₦5 Billion Debt Facility to Scale Solar Mini-grids in Nigeria".

which include lengthy environmental and electricity safety approvals that significantly increase project lead times and transaction costs.[211]

In Nigeria, the Electricity Act (2023)[212] has introduced a more decentralised regulatory structure, allowing state governments and the Rural Electrification Agency to take a greater role in mini-grid approvals, in an aim to prioritise the development and use of renewable energy.[213]

Geographic expansion and diversification

In 2023, Husk launched their Africa Sunshot initiative, targeting 2,500 solar mini-grids by 2030, including 1,000 in Nigeria, 500 in the Democratic Republic of Congo (DRC) and the remaining distributed between Zambia, Madagascar and two additional countries yet to be disclosed.[214,215] To support its entry into the DRC, the world's second-largest unelectrified population, Husk secured a $500,000 grant from Acumen's Hardest-to-Reach (H2R)[216] initiative.

Husk is also exploring opportunities in Southeast Asia, particularly in the Philippines and Indonesia where populations spread across thousands of remote islands continue to rely on diesel generators. The logistical complexity of extending national grids to these remote islands presents a strategic opportunity for Husk's solar hybrid mini-grid model to replace diesel with renewable energy.[217]

In May 2025, Husk launched a dedicated residential rooftop solar brand for India called BEEM.[218] Backed by an AI-powered digital platform that simplifies customer onboarding, technical assessment, installation and energy management, the company enables an affordable and fast transition to clean energy for residential customers.[219]

AI for demand management and customer services

Husk plans to expand its use of AI to the demand side of its operations, introducing mechanisms like time-of-use pricing, which incentivises customers to consume energy during off-peak hours. By managing demand in this way, Husk can further lower the cost of energy production and pass those savings on to its customers.[220]

Husk is also integrating AI in its customer-facing services. The company has developed an e-commerce platform to sell and finance energy-efficient appliances. To enhance this service, Husk plans to use AI to provide personalised customer recommendations, helping users select the right appliances that align with their usage and income levels. This not only creates an additional revenue stream but also stimulates demand for the energy their mini-grids produce.[221]

In parallel, it is piloting the development of AI-enabled virtual power plants (VPPs)[222] that coordinate distributed mini-grids to support national grid stability, an initiative currently underway in Nigeria. It plans to evolve BEEM's residential solar rooftop infrastructure into VPPs that will expand access to clean energy and put energy production and trading in the hands of citizens.[223]

Over the next five years, Husk aims to be operational in five to seven countries across Africa and Asia, deploying 250 to 300 megawatts (MW) of decentralised power-generating assets. Within a decade, the company targets more than 5,000 sites and the management of more than 2 gigawatts (GW)[224] across two continents.

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211. Bandi, V., et al. (2022). "The paradox of mini-grid business models: A conflict between business viability and customer affordability in rural India". *Energy Research & Social Science*. Vol. 89.
212. Policy and Legal Advocacy Centre
213. UNCTAD. (9 June 2023). "Electricity Act 2023 liberalizes the sector and promotes renewables".
214. Husk Power Systems. (5 September 2023). "Africa Sunshot" initiative launched by Husk Power at the Africa Climate Summit, targeting 2,500 solar minigrids over 5 years to supercharge low-carbon economic growth in rural Sub-Saharan Africa".
215. Glinska, G. (4 March 2025). "Husk Power Systems Eyes IPO and Aims to Provide Clean Energy to 100 Million". *The Darden Report*, University of Virginia.
216. Acumen
217. Glinska, G. (4 March 2025). "Husk Power Systems Eyes IPO and Aims to Provide Clean Energy to 100 Million". *The Darden Report*, University of Virginia.
218. BEEM
219. Husk Power Systems. (8 May 2025). "BEEM, a Husk company, launched to rapidly scale India's 30-gigawatt residential rooftop solar market."
220. Deign, J. (10 January 2024). "Why Husk Power believes AI is key to electrifying rural communities". *Latitude Media*.
221. Ibid.
222. A Virtual Power Plant (VPP) is a group of decentralised energy assets that can be controlled remotely as one entity. Enode.
223. Husk Power Systems. (8 May 2025). "BEEM, a Husk company, launched to rapidly scale India's 30-gigawatt residential rooftop solar market".
224. A gigawatt (GW) is a unit of power equal to 1 billion watts. Power measures the rate at which energy is generated, used or transferred. Carbon Collective.

SPOTLIGHT 7: EARTH VENTURE CAPITAL COMBINES FINANCIAL VIABILITY AND IMPACT TO GROW ASIA'S CLIMATE TECH ECOSYSTEM

Earth Venture Capital[225] funds climate tech startups that use advanced technologies like AI, ML, robotics and nuclear technology to build solutions in renewable energy, agriculture, food systems and green manufacturing. While their investment mandate is global, the fund focuses on innovations that can address the climate realities of emerging markets in Asia.

Deep tech climate innovations are often capital-intensive and high-risk, particularly in LMICs. Further, in emerging Asian markets, nascent tech capacity and limited access to long-term financing leave impactful climate tech ventures struggling to scale. In this context, Earth VC takes a long-term, 10-year perspective on impact, distinguishing themselves from investors seeking quick returns on investment. Their investment approach is grounded in the belief that profitability and environmental benefits do not have to be a trade-off – truly sustainable businesses can achieve both.

Of Earth VC's 20-company portfolio, half are based in Europe and North America, while the other half are in developed Southeast Asian countries (Singapore and Hong Kong). In emerging Asian markets, where the deep tech ecosystem is less well established, startups tend to focus on more market-driven solutions. However, what they lack in expertise they make up for in first-hand understanding of the impacts of climate change, which Earth VC's founding partner sees as the impetus for local startups in the near future.

225. Earth Venture Capital

SPOTLIGHT 8: UNDP: THE AI HUB FOR SUSTAINABLE DEVELOPMENT FOSTERS GLOBAL PARTNERSHIPS TO STRENGTHEN AI IN AFRICA

The AI Hub for Sustainable Development aims to accelerate and strengthen local AI ecosystems in Africa. The effort is implemented by the UNDP and co-led by the Italian G7 Presidency. The Hub focuses on AI fundamentals like data, talent, green compute and enabling policy frameworks, while driving collective action in the private sector, which it sees as a key component of resilient African AI ecosystems. The Hub aligns with the Italy-Africa Mattei Plan, a priority of the Italian Government's foreign policy, and highlights the value of combining global AI partnerships across the public and private sectors with local expertise and realities.

Since 2024, the Hub has implemented various pilot programmes to inform the development and co-design of solutions with local actors. This has included the Startup Acceleration Pilot,[226] supporting local innovations and the Local Language Partnerships Accelerator Pilot,[227] to enhance African language inclusion in AI systems. Moving forward, the Hub will draw on lessons from the pilots to scale solutions.

Another flagship initiative at the heart of the AI ecosystem is The Africa Green Compute Coalition (AGCC).[228] In partnership with African and global experts, the AGCC brings together stakeholders to identify solutions for equal, accessible, affordable and sustainable compute access. This includes short-term solutions like cloud investments, as well as long-term pan-African infrastructure efforts, such as building regional GPU clusters to create a more equitable AI future.

FOCUS AREAS ACROSS THE AI VALUE CHAIN

We categorised the applications based on their primary focus within the AI value chain:

Data
33%

Talent
22%

Green Compute
18%

Cross-Cutting
27%

Source: AI Hub

226. AI Hub for Sustainable Development. (n.d.). "AI Hub Co-Design Programmes: Startup Accelerator Pilot".
227. AI Hub for Sustainable Development. (n.d.). "AI Hub Co-Design Programmes: Local Language Partnerships Accelerator Pilot".
228. AI Hub for Sustainable Development. (n.d.). "Building the Africa Green Compute Coalition".

CONCLUSION

This first report in a two-part series has delved into transformative AI innovations across LMICs, highlighting how reliable digital infrastructure, innovative computing techniques and new types of partnerships are foundational to impactful and scalable AI solutions. These case studies have shown that AI is not merely a technological trend but a practical tool for addressing critical development challenges in the health and agriculture sectors to climate action and digital and financial inclusion.

A key insight from our research is the importance of clarifying AI use cases and articulating where they generate tangible value. AI-for-good organisations often struggle to pinpoint how AI specifically improves delivery, whether by lowering costs, expanding access or enhancing service quality. Without this clarity, many rely on donor enthusiasm for AI rather than demonstrating a clear return on investment for impact.

This report addresses that gap by showcasing concrete examples and illustrating how AI creates value within different service models. Funders, venture capital investors, incubators and accelerators should support these organisations to map their business models and use tools such as unit economics and social return on investment to isolate the contribution of AI in their service stack. This approach will help funders and policymakers distinguish where AI truly drives efficiency or inclusion, supporting smarter decisions about where to invest and scale.

With 84% of adults in LMICs owning a mobile phone—three-quarters of which are smartphones,[229] widespread mobile access is enabling both the adoption of AI and the collection of valuable data to design AI solutions that cater to the needs of underserved communities.

The case studies examined in this report demonstrate that mobile technology is fundamental to the architecture and service delivery of impactful AI solutions in LMICs, with innovators either already partnering with MNOs or showing clear potential to do so as they scale. This evidence reinforces the GSMA's role—through its Emerging Tech programme that focuses on fostering the adoption of impactful AI and emerging technologies through partnerships with the mobile industry, will continue to partner with, support, highlight and enable such solutions.

Ultimately, successful AI ecosystems in LMICs require deliberate efforts to de-risk investments, foster capacity building and nurture transparent partnerships that can sustain both innovation and scale. By making the value of AI explicit and measurable, stakeholders can better replicate and scale solutions that deliver meaningful social and economic impact.

This report provides a foundation for such efforts, offering actionable insights for practitioners, funders and policymakers committed to advancing responsible and inclusive AI for development.

The second part of this report will present consolidated lessons and insights from across sectors, use cases and specific solutions.

229. Zhenwei Qiang, C., Straub, S. and Klapper, L. (15 September 2025). "Digital Technology Is Driving the Future of Jobs". World Bank Blogs.

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