



AgriTech

CRAFTING PAKISTAN'S JOURNEY TO IMPACT



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AgriTech: CRAFTING PAKISTAN'S JOURNEY TO IMPACT

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This report has been produced by Tabadlab in collaboration with the GSMA and Telenor and has benefitted from their insights and contribution.

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List Of Abbreviations

Agri DFS	Agricultural Digital Financial Services
ATP	Agriculture Transformation Plan
ADAP	Agro-mall Digital Agriculture Platform
AI	Artificial Intelligence
CNFA	Cultivating New Frontiers In Agriculture
CPEC	China-pakistan Economic Corridor
CAGR	Compounded Annual Growth
DFS	Digital Financial Services
EWB	Electronic Warehouse Receipts
HBL	Habib Bank Limited
HEIS	High-efficiency Irrigation System
IoT	Internet of Things
ICT	Information Communication Technology
IT	Information Technology
IVR	Interactive Voice Response
LSM	Large-scale Manufacturers
MNSFR	Ministry of National Food Security and Research
MSPs	Minimum Support Prices
NADRA	National Database and Registration Authority
NIC	National Incubation Center
NFIS	National Financial Inclusion Strategy
PATTA	Pakistan Agricultural Technology Transfer Activity
PITB	Punjab Information Technology Board
PMT	Proxy Means Testing
SaaS	Software as a Service
SBP	State Bank of Pakistan
SECP	Securities and Exchange Commission of Pakistan
SLACC	Sustainable Livelihoods and Adaptation to Climate Change
SME	Small- and Medium-sized Enterprises
UHF	Ultra High Frequency
VHF	Very High Frequency

EXECUTIVE SUMMARY

Agriculture in Pakistan

Agriculture is a key sector for Pakistan's economy as the highest employer of the labour force, with nearly 40% (or around twenty-five million adults) of the country's employed population working within the sector. Ten million of these are female – which translates to roughly 70% of Pakistan's female employed labour force. Agriculture also constitutes approximately 20% of the country's Gross Domestic Product (GDP), amounting to USD 57 billion in 2021. This makes it the second-highest contributing sector of the economy, after services and followed by industry. Agriculture is instrumental for a host of other major sectors of the economy as it generates the primary inputs and raw materials that fuel the spectrum of firms, from small- and medium-sized enterprises (SMEs) to large-scale manufacturers (LSMs).

Even though Pakistan is categorised amongst the largest agricultural countries, its crop yields are much lower than international benchmarks. Key challenges deterring the growth of Pakistan's agriculture sector include: limited access to formal financial services, high reliance on intermediaries and informal markets to service farmer requirements, limited access to high quality and timely inputs, storage inefficiencies that lead to wastage of agriculture produce, and subpar public service delivery to support farmers' needs.

To address these chronic issues and craft Pakistan's journey to social and economic impact, a long-term approach that benefits both the producers and consumers of Pakistan's agricultural products is critical. With global food security and zero hunger as part of the Sustainable Development Goals (SDGs), and the Fourth Industrial Revolution (4IR) driving hyper-paced advances in economic and social interactions, a critical sector like agriculture merits transformation through structural shifts to embrace technology and digitisation at its core.



GSMA's work on impact enabling technologies has resulted in a conceptual framework for mapping digital agriculture services in five core categories that represent use-cases aligned with the agriculture value chain:

- **Digital advisory services:** Access to information to bridge gaps and asymmetry for farmers.
- **Digital procurement:** Enabling mechanisms for inputs and traceable digital record keeping and transactions.
- **Agricultural e-commerce:** Use of online platforms to facilitate transactions across the agriculture value chain between farmers, aggregators, input providers, and consumers.
- **Agricultural digital financial services:** Provision of mobile and internet payment platforms, credit support to farmers and other services like insurance to service financial requirements.
- **Smart farming:** Use of emerging technologies and solutions like sensors, drones, and satellites to generate and transmit data regarding specific crops, livestock, and farming practices.

The spectrum of use-cases offered by increased use of technology and digitisation in agriculture offer a massive opportunity set for Pakistan to fast-track adoption of modern agricultural techniques that boost national outputs. This can lead to improved outcomes across a range of socioeconomic dimensions as follows:

Impact of AgriTech

Economic Impact

Food Security: Higher production and better utilisation of produce through reduced wastage will increase reliance on domestic sources to service Pakistan's growing demand for food crops. This aligns very closely with the priorities laid out in the National Security Policy 2022 where food security is one of the primary pillars of national security.

Economic Growth: A better performing agriculture sector can help contribute to GDP growth. Increasing average national yield for crops by 30% and reducing post-harvest waste by 75% alone can result in an annual additional impact of USD 8 – 10 billion.

Farmer Prosperity: Smallholder farmers who own five acres or less comprise about 75% of the total agricultural workforce. Through increased profitability, AgriTech can reduce the economic divide between large and small farmers to improve farmer prosperity.

Social Impact

Financial Inclusion: Less than 30% of Pakistan's population is financially included. By digitising transactions and increasing access to credit and loans for small farmers, AgriTech services can become entry points for farmers to become financially included, and eventually create avenues for an increased footprint of digital transactions.

Gender Gap: Of Pakistan's employed female labour force, approximately 70% work in agriculture. This presents a massive window of opportunity to address some of the structural challenges that have led to a gender divide, especially in rural areas. Bringing Pakistan's ten million female agricultural workers into the digital financial fold through agri DFS can double overall female financial inclusion through a single use-case.

Youth Participation: With a median age of 23 years, 64% of Pakistan's population – estimated at 140 million – is younger than 30. A significantly evolved agricultural landscape powered by the promise of technology will not only attract tech-savvy and digitally literate younger age groups to improved economic prospects, but will also create an added incentive to drive innovation and impact in the rural economy, thereby reducing the stress on unplanned and unsustainable urban sprawl.



Sustainability and Climate: Pakistan is a water-scarce country that may face significant challenges by 2025 and yet continues to operate irrigation systems that result in 60% water waste. By optimising use of precious resources, AgriTech can help to make Pakistan more climate resilient. This can be achieved by optimising the mix of inputs, dissemination and adoption of smarter agriculture practices, and innovative financing models for transitioning to improved infrastructure.

Agriculture as a sector is central and connected to a number of Sustainable Development Goals, with the potential to drive cross-sectional impact across a wide range of social and economic development priorities for Pakistan. AgriTech can help improve these impact chains to accelerate improved outcomes and cement Pakistan's international commitments to SDGs.

A flourishing AgriTech vertical requires enabling digital infrastructure that can drive the adoption and uptake of such interventions at the grassroots level. Over the last five years, internet penetration in Pakistan has doubled and presently stands at over 108 million 3G/4G subscriptions.¹ In particular, Covid-19 has accelerated digital adoption with mobile data usage having increased by 77% in the fiscal year 2019-2020. Tremendous strides made with regards to the country's digital landscape are characterised by high dependence on mobile broadband and handheld devices. This presents a great opportunity for AgriTech growth.



Under the 18th Constitutional Amendment, provincial governments have been responsible for policy implementation and service delivery while the federal government continues to operate in a regulatory capacity through the Ministry of National Food Security and Research (MNFSR), coordinating policy formulation, economic coordination, procurement of inputs, and import price stabilisation. The State Bank of Pakistan also assists with agriculture development by regulating, providing, and overseeing agriculture financing, while the Securities and Exchange Commission of Pakistan (SECP) regulates insurance companies and non-banking financial companies. The majority of Pakistan's AgriTech growth has been spurred by the private sector, which plays the dual role of creating and scaling AgriTech solutions. Pakistan's startup ecosystem has shown spectacular growth in the last five years. In 2021 alone, local and international investors poured in capital totalling over USD 350 million² – a higher inflow in 2021 than in the last six years combined.

To meet the needs of the agriculture sector, AgriTech services must grow. The private sector has been a crucial player in expanding Pakistan's AgriTech footprint and integrating technology into the farmer's everyday life. AgriTechs are finally receiving their spotlight moment in Pakistan. Despite positive trends, significant opportunities exist for the ecosystem to grow and support existing and new entrants. To successfully address challenges in the agriculture value chain through technology, private agriculture solutions need to be cultivated through increased capital, government support, and innovation cycles.

Recommendations and Roadmap

A coherent and well-conceived plan with strong execution can help boost the AgriTech segment. While the overall business and innovation environment in Pakistan affects all sectors and consequently AgriTech, focused interventions can help accelerate adoption of AgriTech. The recommendations below aim to lay out a path for this transformation.

Define and Establish the Normative Value and Positioning of AgriTech

Development of a national AgriTech framework that is embedded in policies and action plans at the federal and provincial levels can guide subsequent policy and administrative instruments that identify key, actionable tech based interventions. The framework should include components like principles, priority outcomes, enablers and drivers, resource allocation, delivery mechanisms, engagement, behaviour change, monitoring, and accountability structures.

Enhance Public Sector Digitisation

The established scale and scope of public service structures for agriculture – R&D, extension, machinery, field staff, regulation of inputs, crop estimation – should be leveraged to facilitate awareness, understanding, and adoption of digital services. This can be done by:

- i. Rapid digital transformation of government systems for data management, service delivery and beneficiary engagement and communication.
- ii. Working with private service providers to enable adoption and mainstreaming of services and platforms that help address gaps in public service delivery.

Key areas of focus include supply and demand management, digitisation of extension services and upskilling of farmers, digital identities and profiles of farmers, national agriculture open data regime, and digital markets.

Proliferate Fintech to Support Agri DFS

Offering alternatives to intermediaries as financiers and decision influencers, through digital financial services can enable credit, insurance, and other financial services to unlock significant value in agriculture. A focus on Shariah-compliant financial services and solutions by FinTechs can create an additional appeal for farmers to explore such options. Special attention should be given to agri DFS in terms of utilisation and integration with Raast for tailored use-cases. Agricultural lending targets should be reviewed and set to ensure a significant focus (50% of the lending) is channelled toward smallholder farmers.



Enable Farmers through Digital and Financial Access

Enabling farmers to be able to effectively utilise AgriTech service offerings requires a four-pronged concerted effort:

- i. Improve quality and experience of internet connectivity in rural areas through increased spectrum at affordable pricing and an aggressive fibre optic rollout to connect towers and clusters in rural areas.
- ii. Increase smart device penetration, particularly in the agriculture segments, by rationalising levies on smartphones, increased domestic production and targeted subsidies through integrated programmes.
- iii. Increase digital and financial literacy to enable farmers to engage productively and effectively with available digital solutions.
- iv. Develop integrated service offerings for females that are tailored to addressing challenges specific to the rural context, and increase female participation in use-cases like financial service and market transactions.



Strengthen the Startup Ecosystem with Vertical-specific Support

AgriTech focused incubators and accelerators can be established through cross-sectoral linkages which include agriculture universities, training institutes, technology/telecom service providers, and research institutes. Pakistan Technology Startup Fund can be an encouraging platform to drive focus on AgriTech startups that offer disruptive and scalable solutions for the local market. Exploring an AgriTech Special Technology Zone (STZ) could offer an interesting model that may be extended through local partnerships amongst provinces.

Align the Ecosystem and Reposition Existing Actors

Repositioning existing actors and stakeholders to be integrated in the AgriTech value chain and become enablers that benefit from, and drive trickle down dividends through, technology can be a more viable proposition than reconfiguring the value chain. This can help realign the ecosystem to achieve better outcomes and reduce the lead time for complex change management interventions. Agri businesses that provide inputs or purchase produce and dairy can similarly be positioned in the tech-driven value chain to play a pivotal role in mainstreaming digital adoption for mutually beneficial roles amongst all actors.

Expand Pakistani AgriTechs Across the Globe

Established service providers can mature business models, solutions, and platforms in the domestic market and use these learnings to export services and/or enter new markets that can capitalise on the learning curve already achieved locally. Proactive engagement to conduct roadshows and develop growth opportunities in other emerging markets should be prioritised to further boost technology exports that can generate critical foreign exchange.

Drive Adoption through Behavioural Change and Insights

Alignment of public and private sector approaches towards AgriTech are requisite to establishing trust in the market. Federal and provincial governments should adopt innovative engagement strategies with farmers. Private services and solutions should receive as much attention as public sector and development partner programmes to generate such insights and link them to policy and implementation decision-making. A national unit for behavioural insights that is focused on agriculture and technology can be established at MNFSR to coordinate and lead a representative national agenda that improves decision-making and implementation for greater impact.

1 | AGRICULTURE IN PAKISTAN

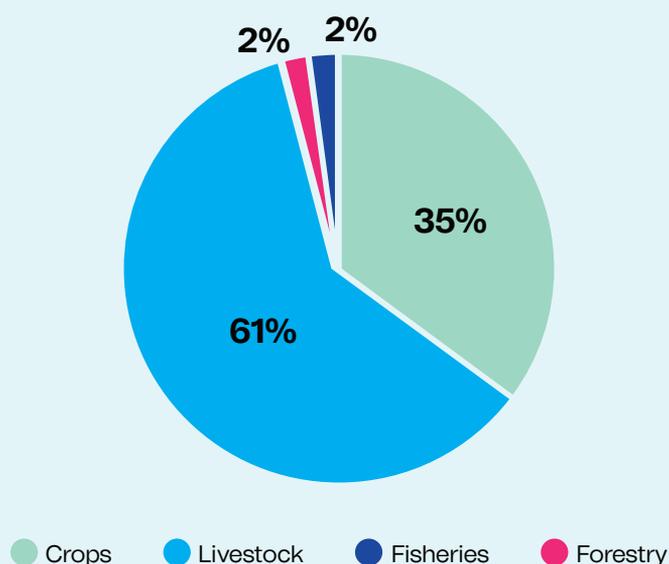


1.1 Significance and Overview

Agriculture is a key sector for Pakistan's economy as the highest employer of the labour force, with nearly 40% (or around 25 million adults) of the country's employed population working in agriculture.³ Ten million of these are female - which means that roughly 70% of the female employed labour force in Pakistan works in agriculture.⁴ Agriculture also constitutes approximately 20% of the country's Gross Domestic Product (GDP), amounting to USD 57 billion in 2021.⁵ This makes agriculture the second-highest contributing sector of the economy, after services and followed by industry. Agriculture is instrumental for a host of other major sectors of the economy as it generates the primary inputs and raw materials that fuel the spectrum of firms, from small- and medium-sized enterprises (SMEs) to large-scale manufacturers (LSMs).

Of Pakistan's total landmass, a quarter is cultivated and used for agricultural production.⁶ Agriculture in Pakistan consists of four key sub-sectors: crops, livestock, fisheries, and forestry. However, almost 96% of agriculture's contribution to GDP comes from crops and livestock, making them the most important ones.

Chart 1: A Breakdown of Pakistan's Agriculture Sector's Contribution to GDP



Source: Economic Survey of Pakistan 2020-21

Pakistan is amongst the world's top ten producers of wheat, cotton, sugarcane, mango, dates, kinnow oranges, and rice.⁷ However, over the years, livestock has emerged as the largest sub-sector in agriculture, independently contributing 11.7% to Pakistan's GDP.⁸ It is a source of foreign exchange earnings and contributes almost USD 1 billion⁹ to total exports. More than eight million rural households (or nearly a quarter of all Pakistani households), are engaged in livestock production and derive approximately 35% of their income from this sub-sector.¹⁰

Table 1: Agriculture Trends Over the Past 10 Years

	2011	2015	2020
Total males employed in agriculture (million)	15.1	14.6	15
Total females employed in agriculture (million)	9.13	9.7	10
Employed persons in agriculture (% of total employment)	45.1%	42.3%	39.2%
Total contribution to GDP (% of GDP)	22%	21%	19%

Source: Pakistan Economic Survey 2011 – 2020, Labour Force Survey 2011 – 2019

Employment and contribution to GDP over the last decade have consistently declined as sectors such as services have taken over agriculture in terms of importance. While growth of the services sector has its advantages, Pakistan can derive enormous economic, social, and sustainability gains from an overall improvement in the agriculture sector.

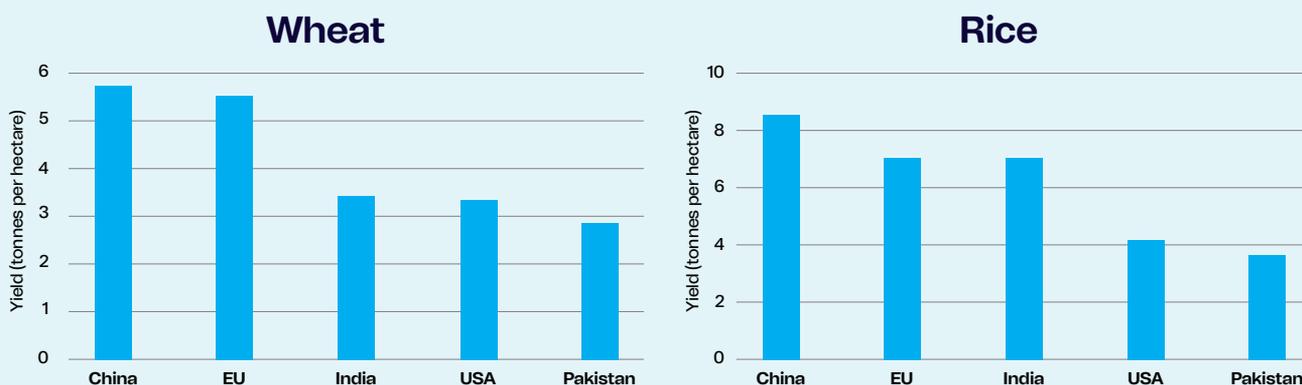
1.2 Challenges

The most substantial gains in agriculture in South Asia occurred during the so-called Green Revolution of the 1960s when a combination of advancements in technology, seed varieties, and other inputs alongside the development of markets, transformed agriculture into a very efficient and productive sector.¹¹ From the 1960s to the late 1980s, the sector's output grew on account of high-yielding and fertilizer-responsive crops, and expansion of the land base and irrigation water supply.¹²

However, productivity in this sector has stagnated over the last decade, resulting in low yields across crops and livestock. Exports of food and cash crops have remained stagnant at around USD 4.5 billion over the last decade, while Pakistan's import bill for food and cash crops has gone up by 63% during the same period.¹³ This means that, as of 2021, the value of food and cash crop imports are double that of exports. Growth is impeded by several factors including financial constraints, misallocation of inputs, and information asymmetry.¹⁴ Further, cropped area of the five traditional crops has largely remained unchanged, while climate change also poses added risks to Pakistan's water availability and food security.¹⁵

Even though Pakistan is categorised amongst the largest agricultural countries, its crop yields are much lower than international benchmarks. A country comparison of crop yields for selected major crops can be observed in the table below:

Charts 2 and 3: Country Comparison of Crop Yield for Wheat and Rice



Source: FAS USDA– International Product Assessment Division [data for 2020-2021]

The dairy and livestock sub-sector also faces similar challenges. Milk production in Pakistan is very low, with average milk yield for cows and buffaloes at 14 and 10 litres per day respectively, which is 5-6 times less than milk yields in high-income countries.¹⁶ Composite farming is an important characteristic of agriculture in Pakistan i.e., most crop farmers also maintain a herd of livestock, which fulfils their working capital requirements. Moreover, the majority of dairy farmers in Pakistan are subsistence farmers and are responsible for approximately 70% of the milk produced.¹⁷ A breakdown of herd sizes is summarised below:¹⁸

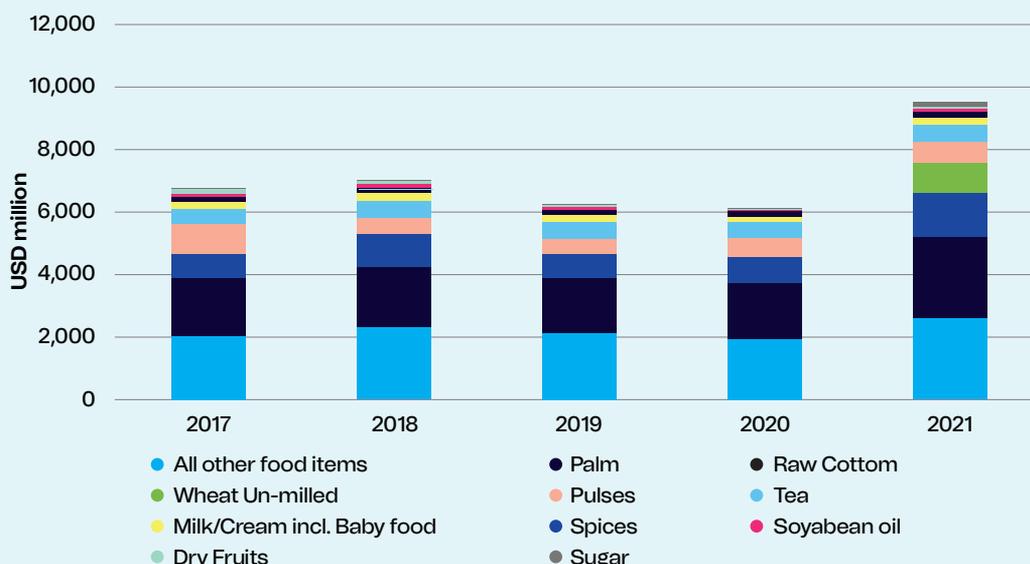
Table 2: Percentage of Cattle and Buffaloes by Herd Size

Herd Size	% of Livestock (Cattle and Buffalo)
1-10	68%
11-20	21%
20+	11%

Source: Pakistan Agriculture Census 2010

As a result of these sub-optimal yields, Pakistan is a net food importer despite being classified as an agrarian economy. Chart 4 below summarises key trends from Pakistan’s food and cash crops imports which soared to a worrisome USD 9 billion dollars in 2021.

Chart 4: Pakistan’s Imports of Food and Cash Crops



Source: Pakistan Bureau of Statistics [data from 2017 to 2021]

Key challenges deterring the growth of Pakistan’s agriculture sector are as follows:

Limited access to formal financial services: Pakistani farmers are financially excluded and predominantly secluded from the formal economy. The local banking industry perceives farmers as a small-ticket and geographically scattered segment. This perception is exacerbated by most farmers’ chequered lending history that categorises them as high credit risk. For instance, the third quarter of 2021 observed 16.7% non-performing loans in the agriculture industry.¹⁹ Consequently, farmers are unable to access essential financial services like loans and credit for inputs to run farm operations.

In Pakistan, 75% of farmers own 5 acres or less, while 15% own 5 to 13 acres.²⁰ However, in most formal lending channels, banks do not engage with farmers who own less than 12.5 acres. Only 4% of total private sector credit in fiscal year 2020-21 went to the agriculture sector, despite agriculture being one of the country’s core economic drivers.²¹

Barriers to finance persist beyond credit. In government insurance schemes, pay-outs offered to farmers or receivers of government credit in the event of natural disasters, are contingent on whether the government declares each occurrence as a “natural disaster” and whether 50% or more of crops suffered from damage.²² This entire process can take eight months to a year, and most of the benefits are transferred to the financing banks.

Intermediaries and informal markets: As a result of low penetration of financial services in agriculture, informal intermediaries, or aarthis, dominate the agriculture value chain with limited regulation, oversight, or formal structures. Farmers place high reliance as a last resort on intermediaries to meet their funding needs for crop cycles. While aarthis cater to a difficult and risky market that is serviced by few others, this market structure dilutes farmers’ margins and limits their ability to both mechanise and modernise their farms. Delayed payments from intermediaries push farmers to borrow more within the same crop cycles, further straining their incomes.

Farmers require capital for inputs like seeds, fertilizer, pesticides, and machinery to manage crop cycles. Resorting to borrowing from intermediaries results in two constraints for farmers: (i) conditions on the utilization of inputs provided or recommended by intermediaries, and (ii) mandatory selling of produce to intermediaries once crops are harvested. These constraints limit the sourcing of high quality and certified inputs by farmers, as many established intermediaries have ancillary businesses that are used to yield margins by channelling inputs to farmers. Secondly, prices set by intermediaries against produce are lower than wholesale and retail pricing, causing farmers to earn less as they face pressure to sell to their lenders.²³ While the first leads to lower yields, the latter reduces margins further for farmers, thereby impacting their income levels.

As with crop production, due to small herd size and production capacity, livestock farmers also rely heavily on the intermediaries to collate and distribute milk to large aggregators/bulk processors.²⁴ These intermediaries also execute binding sales contracts and do not pass on gains when prices are seasonally high in response to lower supply.²⁵

While the government has tried to implement price-setting mechanisms, and to incentivise production by setting minimum support prices (MSP) for major crops, this measure can have additional inflationary consequences or be gamified by intermediaries to hold supply based on anticipated changes in MSP.

Limited access to inputs: Lack of timely access to high-quality inputs, modern machinery, and targeted and timely agronomic advisory remain barriers to boosting yields and farmer welfare in Pakistan. These issues are manifested at three layers:

- Farmers, especially small and remote ones, do not have and/or receive accurate advice on the optimal input mix needed to manage high yield crop cycles. The timing, quantity, and specifications of inputs required are essential to ensure timely and productive decisions.
- Sub-standard and/or counterfeit inputs are abundantly available in the market without verification services and provide a lower cost alternative to already capital-constrained farmers. Utilisation of these inputs results in lower yields.
- Preference for high quality inputs requires higher capital, and if provided by intermediaries, limits options for farmers in some instances since inputs are provided in kind as part of the lending arrangement. This crowds out the demand for high-quality inputs thereby resulting in a low-cost, low-yield cycle.

The government has attempted to address this challenge by providing smart subsidies for inputs such as fertilisers. However, the majority of subsidised inputs eventually end up with large manufacturers or intermediaries who sell them to farmers at market prices, often rendering subsidy schemes ineffective.

Storage inefficiencies: A Pakistani farmer is always a distressed seller. Whenever a perishable crop is harvested or milk is produced, farmers face the challenges of storage and perishability of their produce. The total production of vegetables and fruits in Pakistan, for example, amounts to 13 to 16 million tonnes, of which 35-40%²⁶ is estimated to be wasted post-harvest. Many of these losses are owed to poor logistics, processing and storage inefficiencies. This weakness is exploited by the market, compelling the farmer to sell in haste and receive unfair pricing for agricultural produce.



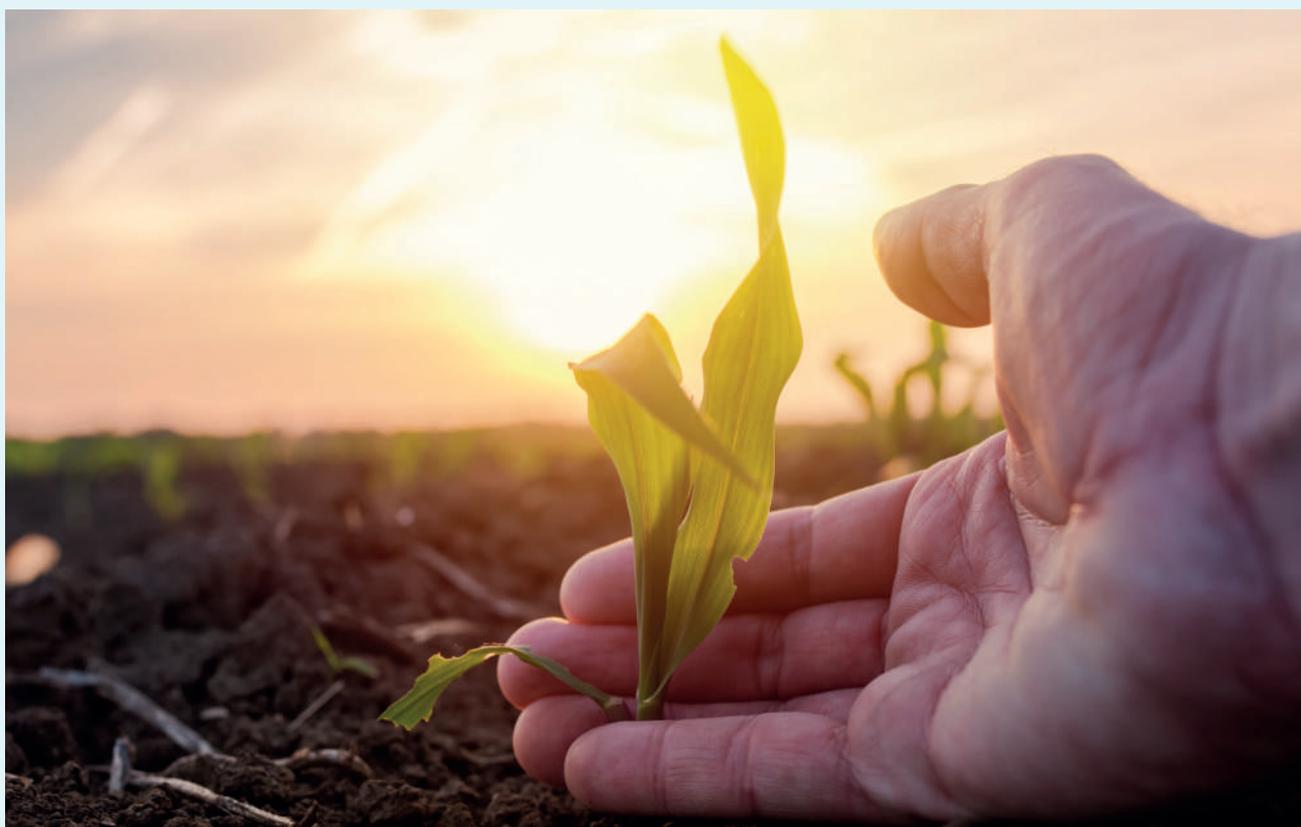
Subpar public service delivery:

Specialised agriculture services like extension, agriculture machinery, and transfer of technology offered by the public sector are hampered by slow execution and low capacity. In particular, agriculture extension services (farmer training, education, and engagement to share improved farming methods and techniques) fall under the ambit of provincial governments. However, the traditional person-to-person model of extension cannot serve the needs of a rapidly evolving agriculture sector. As an example, the ratio of extension agent to farmer household remains low and stands at about 1 to 9,500 for Punjab.²⁷ Enhancing the capacity of extension agents, ensuring service quality in terms of timelines and coverage, and monitoring performance are cumbersome activities that require robust governance structures to ensure high-quality services for beneficiaries.

1.3 Transforming Agriculture-Thinking About the Future

All these challenges exacerbate the vulnerability of over 25 million livelihoods, contribute to soaring food prices, widen Pakistan's trade deficit, threaten sustainability and food security, and further endanger vulnerable groups. Pakistan's agricultural market competitiveness compared to its international counterparts is also based on the quality and quantity of the products being produced and exported. With gaps in formal financial services to the tune of USD 5 billion,²⁸ a food and cash crop trade deficit of USD 4.63 billion, and average daily earnings of less than USD 2²⁹ for Pakistani farmers, serious interventions are necessary to improve livelihoods and meet the nine million tonne gap in Pakistan's food needs.³⁰

Such interventions have already begun to demonstrate impact around the world. Since the first Green Revolution, global agriculture practices have come a long way, especially due to technological advancements. To ensure food security and economic prosperity, Pakistan too needs to significantly improve and innovate the agriculture ecosystem. At the very least, it needs to modernise its supply chain and adopt the latest production techniques, innovative agricultural inputs, and tools. As a result, improved yields and higher productivity will not only meet domestic demands to improve food security, but also actualise Pakistan's export potential, provide import substitutes, and minimise trade deficit at a swing of almost USD 10 billion.

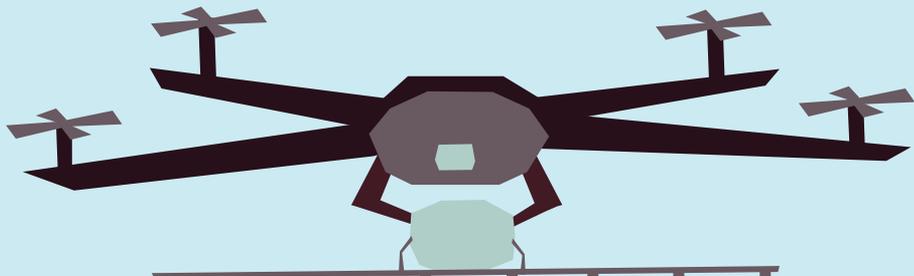


Similarly, the compound effect of better production and selling mechanisms will have a profound socioeconomic impact on the lives of millions of farmers living in abject poverty. If a smallholder farmer, representative of most Pakistani farmers, cannot produce his required yields for the year, it has a devastating impact on his ability to invest in new crops and to provide for his household, creating a multiplier effect that damages his own livelihood and that of his family. Without a strategic shift, tens of millions of lives and livelihoods will continue to remain at risk.

To address these chronic issues and craft Pakistan's journey to social and economic impact, a long-term approach that benefits both the producers and consumers of Pakistan's agricultural products is critical. With global food security and zero hunger as part of the Sustainable Development Goals (SDGs), and the Fourth Industrial Revolution driving hyper-paced advances in economic and social interactions, it is hard to imagine a state whereby a critical sector like agriculture does not undergo structural shifts to embrace technology and digitisation at its core. In the next chapter, we examine the potential of AgriTech and digital agriculture services in contributing to such impact.

2

THE CASE FOR AGRITECH IN PAKISTAN



2.1 Use Cases and Applications of Technology in Agriculture

Agricultural technology, or AgriTech, refers to the use of technology to improve agricultural practices and techniques for increased output and improved outcomes. Over the twentieth century, steady advancements in technology and innovation accelerated rates of production and improved the use of labour and resources in agriculture. In particular, the onset of the Green Revolution in the 1960s introduced high-yielding varieties of crops, use of chemical fertilizers, and high-efficiency mechanization and automation.

In the past two decades, agricultural production has undergone a period of rapid digital transformation that is driven by digital connectivity, data systems, artificial intelligence (AI) and analytics, Internet of Things (IoT), robotics, sensors, and imagery devices. Private sector investment in AgriTech is also rapidly increasing. In 2020, global venture capital activity in AgriTech amounted to almost USD 5 billion, double that observed during 2019 or 2018.³¹

The spectrum covered by agricultural technology is very vast and includes areas like research and development in biotechnology, crop varieties etc. For the purpose of this report, we focus on agriculture services that can digitalise the agriculture value chain. Such services are of particularly high importance for lower-middle income countries like Pakistan, where sector performance is constrained by a host of factors that can be aided by digital technology. From information services to smart farming, they hold the potential to produce efficient and effective mechanisms for farmers, enhance their livelihoods, and grant them more agency over yields. In the longer term, these interventions can also help contribute to mitigating challenges like climate change.

Digital agriculture services may be organised into the following five use cases as per GSMA's framework for digital agriculture services:³²

Digital Agriculture Use Cases and Sub-use Cases

Access to services		Access to markets		Access to assets
Digital advisory	Agri digital financial services	Digital procurement	Agri e-commerce	Smart farming
Agri VAS	Credit and loans	Digital records	Inputs	Smart shared assets
Smart advisory	Input financing	Digital records with payments	Outputs	Equipment monitoring
Weather information	Credit scoring	Digital records with traceability	Inputs and outputs	Livestock and fishery management
Pest and disease management	Crowdfunding	Digital records with payments and traceability		
Product verification	Insurance			
Record verification	Digital agri wallet			
	Savings			
	Accountability tools			



Source: GSMA



Digital Advisory

Digital advisory services aim to address information gaps and bridge asymmetry for farmers. These services provide timely and accurate information at low cost through devices (calls, SMS, IVR, apps). Information covers market prices, nutritional information, weather data, and crop and livestock health. They can also enable farmers to access information about pests and crop disease and relay innovative farming practices from which other farmers can learn. Applications using AI and big data in particular can tailor advisory services to produce targeted insights on farming practices for individual needs. They allow for use cases that range from forecasting weather to managing risk, predicting optimal times for feeding and harvesting, and monitoring soil and crop health. For instance, companies like Farmspeak Technology in Nigeria use AI to diagnose poultry diseases.³³

Digital Procurement

Digital procurement in farm management refers to the enabling mechanisms for inputs and traceable digital record keeping and transactions. Recent developments have integrated payments in digital procurement tools, which allows agri businesses to reduce risk associated with theft and fraud in a more transparent process. A transformational effect of digital procurement is the creation of a digital profile for farmers, enabling them to access other digital services like advisory, e-commerce, and digital financial services. Digital procurement solutions are typically available as Software as a Service (SaaS), such as TaroWorks, a SaaS solution that serves over 30 countries by providing mobile forms to log progress and create a feedback loop between extension offices and field agents.³⁴

Agricultural E-Commerce

Agricultural e-commerce (agri e-commerce) services use online platforms to facilitate transactions across the agriculture value chain between farmers, aggregators, input providers, and consumers. These can cover direct access to markets, providing more choice to farmers and allowing them to potentially increase profits through lower reliance on intermediaries. Zambia's Lima Links, for instance, connects farmers to buyers and aggregates demand by allowing groups to place bulk orders on USSD-based platforms that are more accessible to rural residents.³⁵ Related digital marketplace services often extend beyond linking buyers to sellers and can additionally offer marketing, customer care, logistics, warehousing, and pre-financing to farmers.

Agricultural Digital Financial Services

Agricultural digital financial services (agri DFS) provide mobile and internet payment platforms, and credit support to farmers. Agricultural credit includes long-term finance for livestock, tractors, implements, farming systems and other physical equipment, as well as short-term finance for crop production, mechanization services, and related daily operating expenses.

Other financial services include lending against electronic warehouse receipts (EWR), insurance or savings through digital wallets, and credit-scoring solutions outsourced by third-party companies. An instance of EWRs is Turkey's ELUS Transaction Platform, a registry for electronic product bills for farmers and logistics agents delivering products to warehouse facilities. Systems like ELUS promote easier and transparent transactions within the agriculture ecosystem and reduce dependence on intermediaries over time.

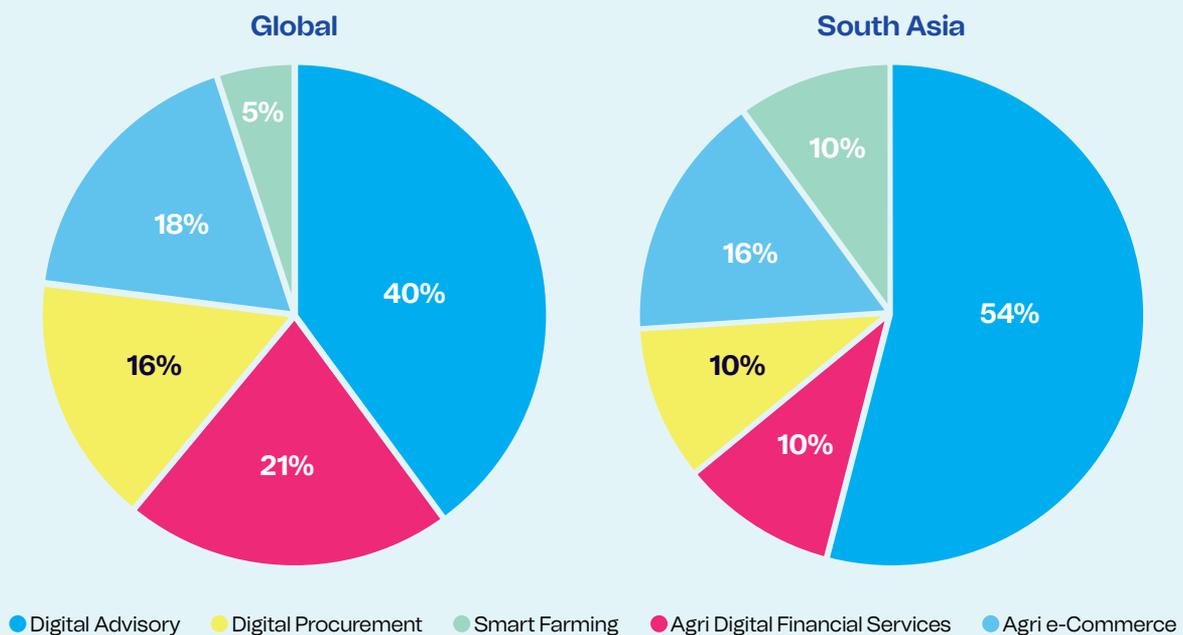
Smart Farming

Smart farming uses sensors, drones, and satellites to generate and transmit data regarding specific crops, livestock, and farming practices. These services rely on connectivity between IoT devices, robotics, and AI to optimise productivity at reduced costs and to improve decision making. Key areas of smart farming include remote equipment and monitoring solutions, livestock and aquaculture management, and smart shared-assets solutions that enable farmers to access equipment.

These areas are enabled by a variety of technologies such as the Internet of Things, a system of physical devices interconnected by software and data exchange that is utilised during the life cycle of different crops and livestock to increase automation and improve efficiency. IoT solutions have begun growing in South Asian countries where farmers are heavily reliant on livestock management.³⁶ An example is India's Stellapps, a dairy technology solutions company that creates smart collars. Robotics and engineering are also used for agricultural automation by mechanising processes and practices. Examples include drones that are equipped with sensors for monitoring and capturing data of crops. Their multi-spectral sensors facilitate precision farming management systems.³⁷

As depicted in the charts below, 40% to 54% of all digital services focus on digital advisory, making it the leading use-case globally and in South Asia.

Charts 5 and 6: Global and South Asian Overview of Active Digital Agriculture Services by Use Case, January 2020

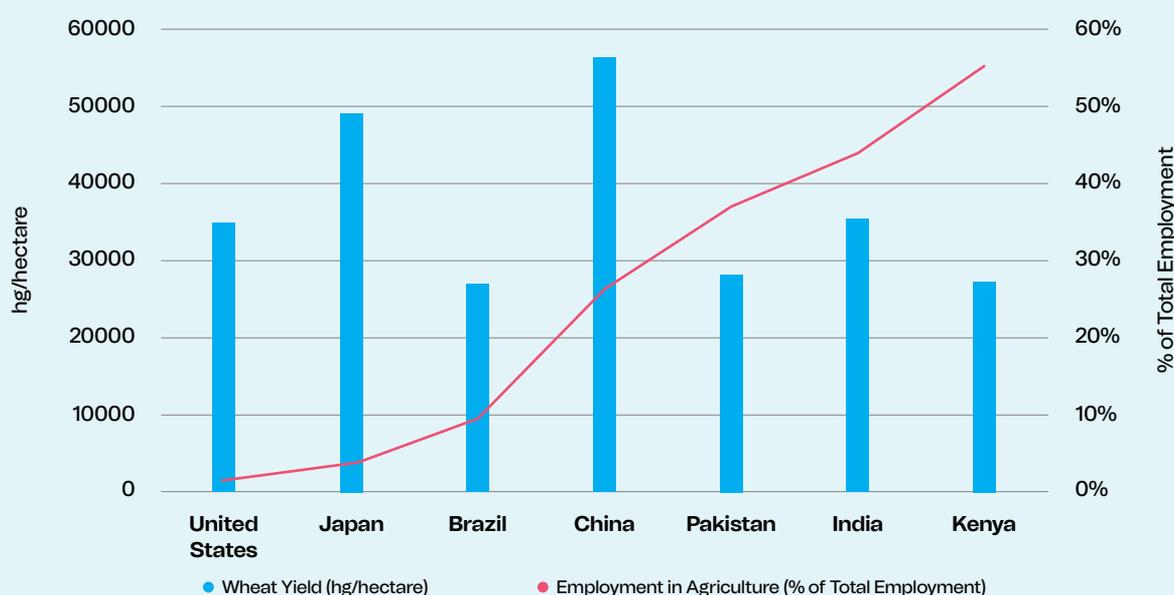


Source: GSMA Digital Agriculture Maps 2020

2.2 How Technology in Agriculture Creates Impact

A wide spectrum of factors influences development, adoption, and innovation in AgriTech. Developed economies that benefit from early automation and high-efficiency mechanisation, established research and development programmes, and adequate financial resources are at the forefront of the AgriTech revolution. As illustrated in Chart 7, developed economies such as the United States are able to produce greater crop yields despite lower total employment in agriculture compared to emerging economies like Pakistan, where agriculture constitutes a larger percentage of total employment. This demonstrates that despite smaller agriculture workforces, they have been able to automate and digitise many of the processes that contribute to agricultural productivity.

Chart 7: Comparison of Wheat Yields Versus Employment in Agriculture, Globally



Source: FAO, World Bank 2018-19

Pakistan has yet to come out of the glory of the green revolution of the 1960s when mechanical tools and modified inputs, latest at the time, were introduced to increase the productivity of the agriculture sector. Since then, technology adoption has stagnated with legacy machinery and implements still in use. Even though Pakistan is among the world's largest producers for multiple staple and cash crops like wheat, rice, and cotton, the per hectare yield of those crops is 50% to 80% lower than the international benchmarks for such crops.³⁸ This alone presents a significant opportunity for Pakistan to fast-track adoption of agricultural techniques that boost national outputs. This can lead to improved outcomes across a range of socioeconomic dimensions as follows:

Economic Impact

Given the strategic importance of agriculture in Pakistan's economy, AgriTech can play an instrumental role by:

- Improving yields through timely and more sophisticated advisory, higher quality inputs, and increased adoption of improved farming techniques/mechanization.
- Reducing wastage of agriculture produce through more sophisticated logistics, access to markets and digital procurement.

Food Security: Higher production and better utilisation of produce through reduced wastage will increase reliance on domestic sources to service Pakistan's growing demand for food crops. This can also help offset Pakistan's food crops import bill which reached USD 9 billion in 2021 and aligns very closely with the priorities laid out in the National Security Policy 2022 where food security is one of the primary pillars of national security. The NSP intends to achieve "a Pakistan that is food secure while adopting climate resilient agriculture and contributing to value-added exports after meeting domestic demand."³⁹

Examples from other countries and regions provide early evidence of the impact of AgriTech in improving yields. For example, AI- and IoT-based Sowing App launched in India in 2016 has allowed 174 farmers to achieve an average of 30% higher yield per hectare as per the latest data.⁴⁰

Economic Growth: Increased supply can also help farmers improve their profitability. For instance, Ignitia, a climate smart weather prediction service based in Ghana and Nigeria, has shown that farmers experienced up to an 80% increase in their income with decreased risk and loss associated with their farming practices.⁴¹

A better performing agriculture sector can help contribute to GDP growth. Increasing average national yield for crops by 30% and reducing post-harvest waste by 75% alone can result in annual additional impact of USD 8 – 10 billion.⁴² This can bring a needed push to economic opportunities and related sectors in Pakistan, while also creating jobs in the local market.

Farmer Prosperity: Smallholder farmers who own 5 acres or less comprise about 75% of the total agricultural workforce. Through increased profitability, AgriTech can reduce the economic divide between large and small farmers to improve farmer prosperity. Empowering smallholder farmers by increasing their profits can allow them to take more commercial risks and make long-term investments for improving yields.

Such was observed with Pinduoduo in China, whose platform used a distributed AI approach to aggregate consumer demand and generate large orders for farmers. In 2018, Pinduoduo helped over 680,000 farmers located in low-income counties sell produce online and processed orders worth a total of USD 9.7 billion.⁴³

Social Impact

Financial Inclusion: In Pakistan, less than 30% of the population is financially included.⁴⁴ By digitising transactions and increasing access to credit and loans for small farmers, AgriTech services can become entry points for farmers to become financially included. Broadening Pakistan's digital financial market can create four million jobs, increase deposits in circulation by USD 250 billion, and increase the GDP by 7%.⁴⁵ Furthermore, it can improve documentation and bookkeeping through transaction histories and contribute to improved documentation of the economy.



Gender Gap: Of Pakistan's employed female labour force, about 70% work in agriculture.⁴⁶ This presents a massive window of opportunity to address some of the structural challenges that have led to a gender divide, especially in rural areas. By improving profitability of farmers and financially including women through agri DFS, the female labour force can be empowered and enabled to become more economically and socially productive. Since only 7% of Pakistani women own bank accounts, bringing Pakistan's 10 million female agricultural workers into the digital financial fold through agri DFS can double overall female financial inclusion through a single use-case. In addition, women are likely to spend finances on family wellbeing. In households where women control finances, a child is 20% more likely to survive to adult age.⁴⁷

Early impact of agri DFS on increasing female farmers' income is demonstrated through the Niger Irrigation Project, active between 2016 and 2019 as a collaboration between Netafim and the International Financial Corporation (IFC)⁴⁸ to provide family-based drip irrigation systems, solar pumps, and microcredit in addition to expertise, training, and support. The program has taught over 300 farmers, of which 50% are women, to use these systems. Farmers who have participated in this programme report water savings of 30% to 40%, improving female farmers' ability to contribute economically as a result of increased okra and watermelon produce.⁴⁹

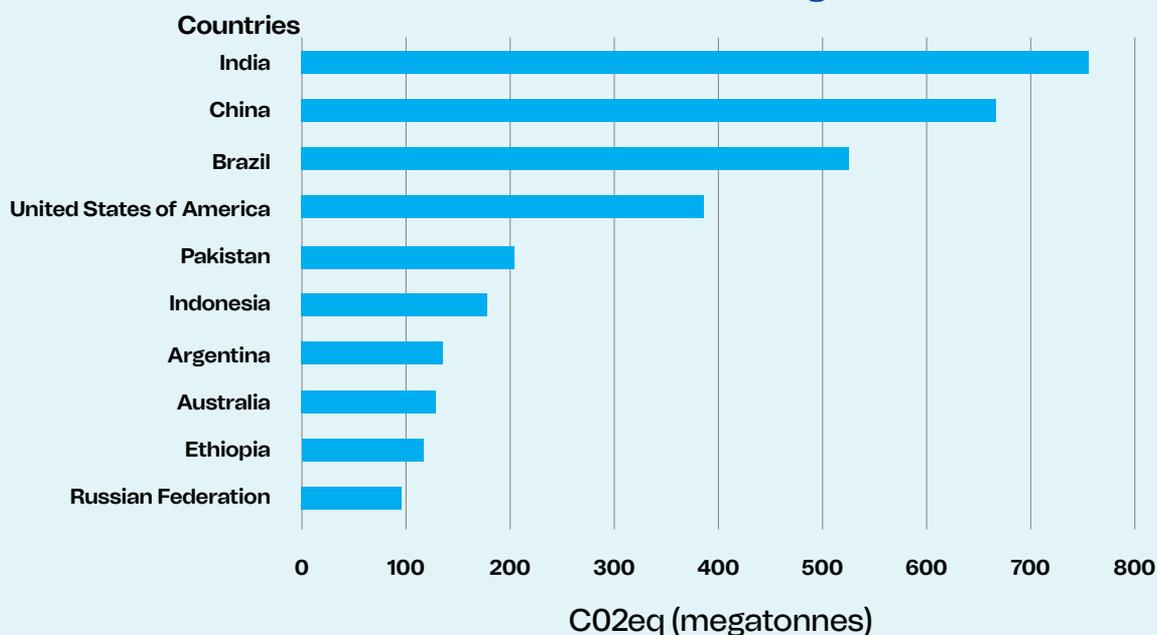
Youth Participation: With a median age of 23 years, 64% of Pakistan's population, estimated at 140 million, is younger than 30.⁵⁰ A significantly evolved agricultural landscape powered by the promise of technology

will not only attract mobile-savvy and digitally literate younger age groups to improved economic prospects, but will also create an added incentive to drive innovation and impact. Creating alternatives and repositioning the role and hold of intermediaries can open avenues to introduce new techniques, develop new services, and generate higher returns. Values such as transparency, accountability, sustainability, and social responsibility blended with a corporate flavour can further enable creation of more attractive jobs. This combination of factors in a transformed value chain can potentially develop pathways for youth engagement and participation in the agriculture sector, where the workforce has shrunk at a negative CAGR of 1.39% over the past decade (as per Table 1) despite considerable population growth. In turn, increased rural job opportunities can reduce the population burden and associated pressure on urban centres, where almost 40% of Pakistan’s population now resides, and create economic opportunities growth in rural areas.

Sustainability and Climate Resilience

Pakistan is a water-scarce country that may face significant challenges by 2025 and yet continues to operate irrigation systems that result in 60% water waste.⁵¹ By optimising use of precious resources, AgriTech can help to make Pakistan more climate resilient. This can be achieved by optimising the mix of inputs, dissemination and adoption of smarter agriculture practices, and innovative financing models for transitioning to improved infrastructure. Once adopted at scale, individual farm holdings can contribute to better climate readiness at the national level. For instance, Distinct Horizon, an India-based AgriTech launched in 2015 is tackling climate change by developing machinery that reduces fertiliser consumption by 40%.⁵² Such technology can be pivotal for Pakistan, which is among the top 10 countries in carbon dioxide equivalent emissions as per Chart 8 below:

Chart 8: Top 10 Countries by Carbon Dioxide Equivalent Emissions from Crop and Livestock Emissions within the Farmgate in 2019

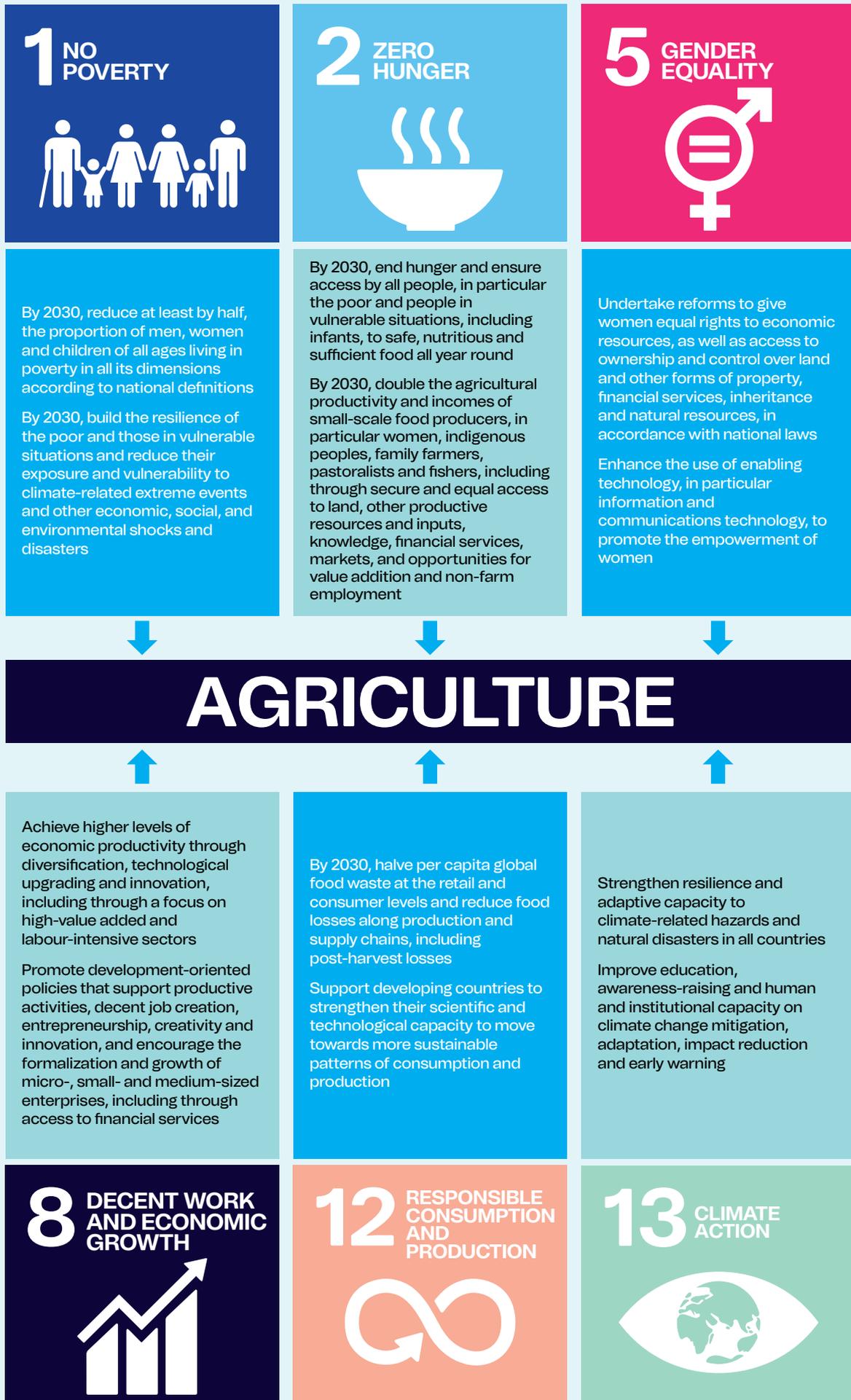


Source: FAOSTAT (2020)

Furthermore, according to the Government of Punjab, high-efficiency irrigation systems (HEIS) alone can result in 50% water conservation and increase farmer income per acre per annum by PKR 75,000.⁵³ If HIES were implemented in just 5 million acres, it could result in a total of USD 2 billion of additional annual income for one province alone.

Agriculture as a sector is central and connected to a number of Sustainable Development Goals with the potential to drive cross-sectional impact across a wide range of social and economic development priorities for Pakistan. The mapping on next page shows the reach and span of such impact as analysed through alignment with SDGs. AgriTech can help improve these impact chains to accelerate improved outcomes and cement Pakistan’s international commitments to SDGs.

Figure 1: United Nation Sustainable Development Goals (SDGs) Aided by Agritech



How Big Tech is Enabling Farmers in the Global South

In recent years, Big Tech companies have invested in AgriTech programmes that focus on farmers at various scales around the world. The unmatched resources of Big Tech companies enable them to launch and scale agricultural solutions faster than local companies or startups. IBM, for instance, launched Watson Decision Platform for Agriculture⁵⁴ in 2019 to customise low-cost solutions using IoT and AI for improved decision making and sustainable farming practices. The platform was recently used by Indian AgriTech Saaf Water,⁵⁵ a water quality sensor and analytics platform, to increase access to water quality information, and by smallholder coffee and cocoa farmers in Honduras⁵⁶ to improve supply chain transparency.

Similarly, Microsoft FarmBeats⁵⁷ combines IoT sensors, data analysis and machine learning to augment farmer knowledge through data-driven insights. To address lack of internet connectivity in rural areas, the agriculture sensors used by FarmBeats utilizes TV white space, or unoccupied slices of the UHF and VHF radio frequencies used for TV broadcasts, to retrieve extra bandwidth for mobile phones. Many developing countries are experimenting with this technology for internet connectivity as an affordable means to implement IoT-based technologies.

Why Agritech is Growing in India

India, one of the largest agricultural economies in the world, faces challenges similar to Pakistan. These include growing pressure on natural resources like water, informal markets, fragmented land holdings of small farmers, and supply chain challenges linked to the dominant role of intermediaries. Increased internet penetration, affordable digital devices in rural areas and a growing population of young people interested in integrating agriculture with recent technological advancements have led to a rapidly growing AgriTech market. Furthermore, earlier successes witnessed in FinTech and EdTech, coupled with more organised demand in the agriculture sector, have convinced investors to pay attention to the agriculture value chain.

Covid-19 also played a significant role in boosting AgriTech adoption by forcing farmers to turn to digital means in the wake of closed mandis and intermediary services, resulting in 85%⁵⁸ of AgriTech startups reporting increased demand during the first wave. Presently, the country boasts about 600 to 700 AgriTech services. By 2025, the AgriTech sector in India is expected to grow to USD 30 to 35 billion.⁵⁹

Matching Markets in Sub-Saharan Africa

Matching markets improve smallholder farmer access to mechanization services with reduced costs through digital platforms that provide farm machinery on rent. Buying physical machines upfront is associated with high cost. This intervention provides affordable access to expensive machinery for farmers by putting underused assets to work by matching suppliers with farmers. For instance, a study in Zambia showed that hiring tractor services enables farmers to expand their cultivated area and consequently increase their income.⁶⁰ One such service is Hello Tractor, which matches tractor owners with smallholder farmers in need of tractor services via simple text messages in Ghana, Kenya, and Nigeria.⁶¹ Hello Tractor has also recently partnered with Good Earth Pakistan by allowing the latter to use their technology to match machinery owners and farmers.

In Sub-Saharan African countries like Nigeria, the growth of such AgriTech services have been aided by the government, which has introduced incentives such as provision of loans and inputs in cash and kind. These programmes allow AgriTechs to participate as service aggregators in the value chain. An Agriculture Promotion Policy backed these interventions with the aim to “commercialise new agricultural technologies that meet local market needs.”⁶²

3

PAKISTAN'S AGRITECH ECOSYSTEM



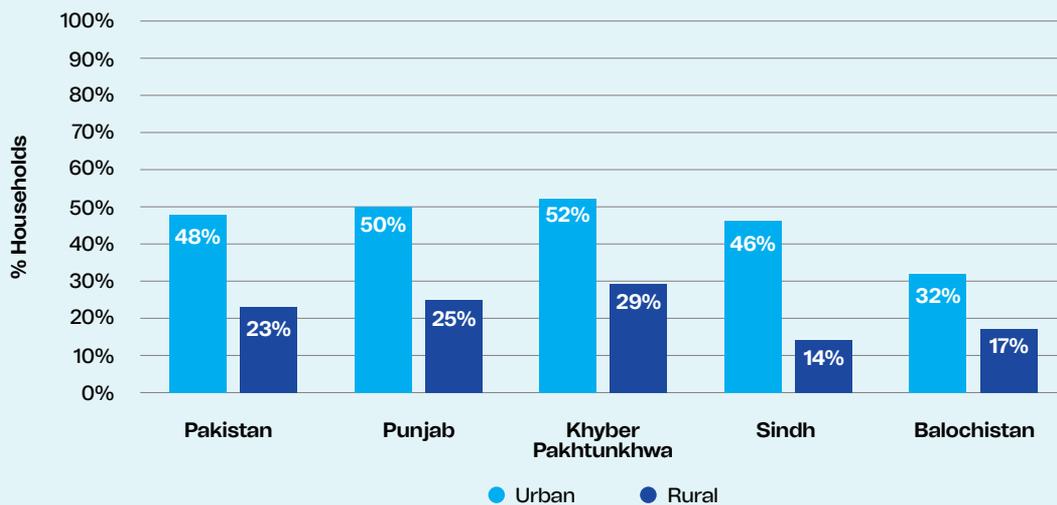
3.1 Pakistan's Digital Adoption Snapshot

AgriTech operates at the intersection of the technology and agriculture ecosystems, making it important to understand and analyse drivers and trends of digital technologies as means to unpack AgriTech in Pakistan.

A flourishing AgriTech vertical requires enabling digital infrastructure that can drive the adoption and uptake of such interventions at the grassroots level. Over the last five years, internet penetration in Pakistan has doubled and presently stands at over 108 million 3G/4G subscriptions.⁶³ In particular, Covid-19 has accelerated digital adoption with mobile data usage having increased by 77% in the fiscal year 2019-2020. Tremendous strides made with regards to the country's digital landscape are characterised by high dependence on mobile broadband and handheld devices. This presents a great opportunity for AgriTech growth.

As of 2021, Pakistan ranks 90th out of 120 on the Inclusive Internet Index, the lowest score in South Asia.⁶⁴ Availability of internet services is heavily concentrated in metropolitan areas, while rural and remote areas have a limited digital footprint. Rural households in Pakistan are more than twice as likely not to have an Internet connection compared to urban households, despite being as almost just as likely to own at least one smartphone.⁶⁵

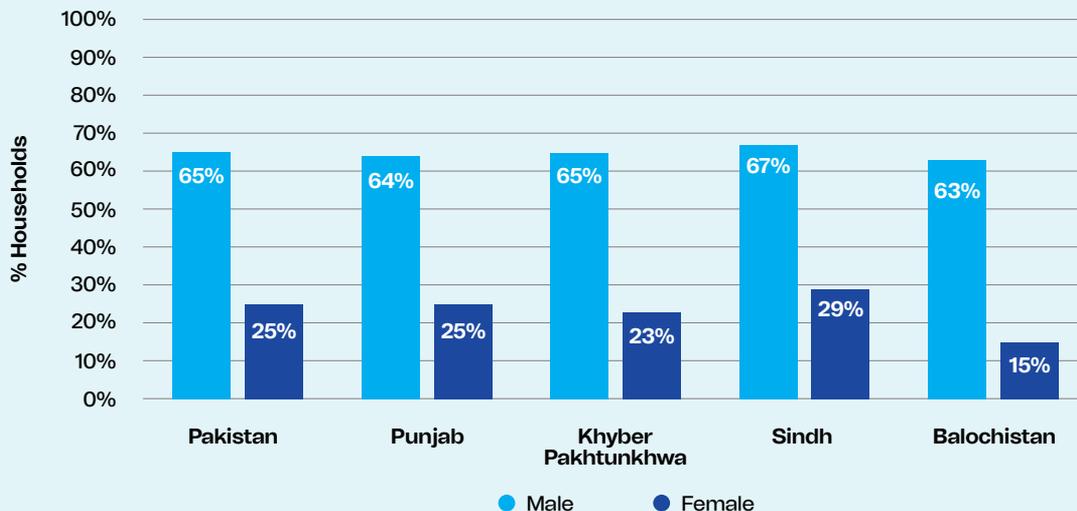
Chart 9: Urban and Rural Households with an Internet Connection in Pakistan



Source: PSLM Survey 2019 - 2020

On an individual level, however, smartphone ownership is limited to less than half of individuals 10 years or older.⁶⁶ Critically, the gender gap in smartphone ownership stands at about 40%, as women are about 2.6 times less likely to own smartphones than men.⁶⁷ Given that the majority of female workers in Pakistan are in the agriculture sector, expanding female smartphone ownership can be critical for AgriTech uptake.

Chart 10: Mobile Phone Ownership Among Males and Females Aged 10+ in Pakistan



Source: PSLM Survey 2019 - 2020

INFRASTRUCTURE AND QUALITY



Only **9%** of cell towers in Pakistan are connected to fibre optic cable, below regional average



One of the **lowest** levels of spectrum allocation regionally and globally



Average DL/UL speeds across mobile technologies is at **15.8 Mbps**, below the South Asian average

AFFORDABILITY



One of the cheapest mobile broadband prices in the world at **USD 0.48 per 1.5 GB**



High taxation with handset levies as high as PKR 9,000 and taxes ranging from **15-17%**



Production of local handsets stood at **25 million** handsets in **2021**; however, it is concentrated in 2G phones

DIGITAL LITERACY



Literacy rate is stagnant at **50%** in rural areas over the past decade



45% of the population is able to browse social media as per government data. Alternate estimates indicate **24%**

GENDER NORMS



Women are almost **3** times less likely to own phones than men as a result of attitudes towards gender



Lack of digital privacy and risks of cyber harassment further increases restrictions

A closer look at Pakistan's internet penetration and device ownership reveals the following:

Infrastructure and Quality: Poor internet speed and coverage inhibit internet accessibility. Only 9% of cell towers in Pakistan are connected to fibre optic cable, compared to international benchmarks of approximately 40% for peer countries, resulting in a compromised experience from 3G and 4G connectivity. Furthermore, low spectrum allocation and high taxation and licensing fees on the telecom sector inhibit the expansion of mobile broadband, particularly in rural areas. The average internet download and upload speed across mobile technologies in Pakistan is at 15.8 Mbps,⁶⁸ below the South Asian average of 17.3 Mbps.⁶⁹ These speeds vary with network conditions and are much lower in remote areas.

Affordability: Despite boasting one of the cheapest mobile broadband prices in the world at USD 0.48 per 1.5 GB of mobile broadband,⁷⁰ the cost of internet usage remains high due to mobile sector taxation. This level of taxation impacts mobile devices, SIM cards, and internet data, with mobile handset levies as high as PKR 9,000 and sales tax that ranges from 17% to 19.5%.⁷¹ Local supply of mobile phones, despite having almost doubled in production between 2020 and 2021 at a total 25 million devices, mostly produces 2G-enabled phones and does not sufficiently meet demand. This especially increases the cost of device ownership due to high import duties for smartphones.

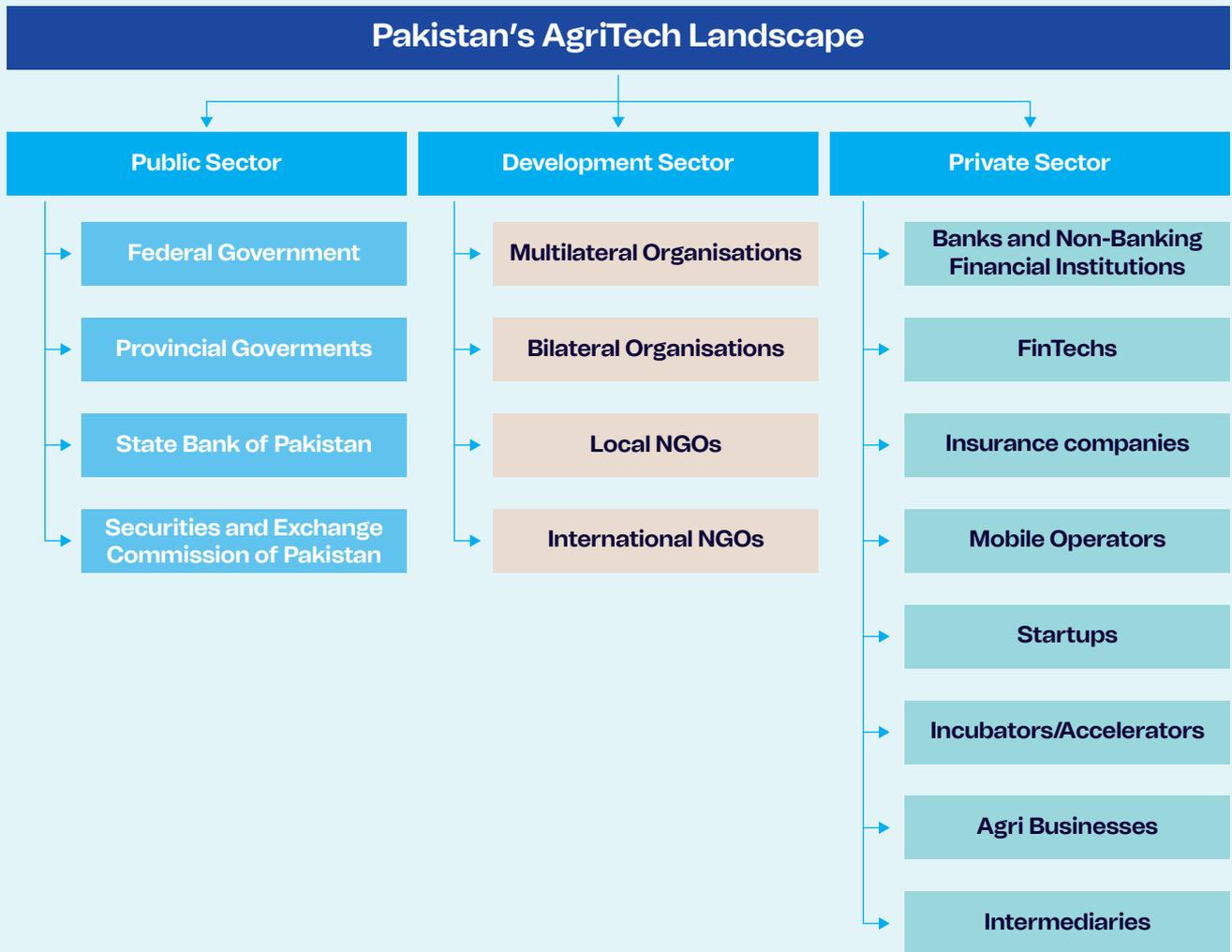
Digital Literacy: One factor of the digital divide is low digital literacy. While digital literacy does not always require the ability to read, it is nevertheless complemented by Pakistan's poor literacy rate, which is stagnant at 50% in rural areas.⁷² Lack of digital literacy and skills amongst the rural population can hinder uptake of app-based AgriTech services. Although there exists a moderate degree of internet awareness and mobile ownership, lack of digital literacy limits meaningful engagement with digital interfaces and services. These digital skilling constraints further contribute towards the digital divide.

Gender Norms: Low smartphone ownership amongst women is largely perpetuated by attitudes towards gender, where men are predominant smartphone owners, particularly in low-income households. Lack of digital privacy and risk of cyber harassment also present threats to increased digital adoption by females, the latter of which further increase restrictions from parents and spouses. Lack of digital freedom for women severely limits their ability to participate in the digital economy or secure innovative means for social and economic prosperity. Without expanding digital access for women, the proliferation of AgriTech will not deliver the full extent of its potential impact for Pakistan at large.

3.2 Understanding the Ecosystem

In Pakistan, we have an intersection of multiple entities that can play their role in the initiation and evolution of AgriTech as an established vertical. A visual representation is depicted below. While the development sector, including multilateral and bilateral organisations and international non-government organisations, play a role in supporting government's strategic priorities in the sector through development funding, technical assistance, and capacity building, for the purpose of this report, for this chapter we focus on AgriTech in the public and private sectors as key contributors to solutions and services.

Figure 3: Stakeholder Map of the AgriTech Landscape



3.2.1 Public Sector

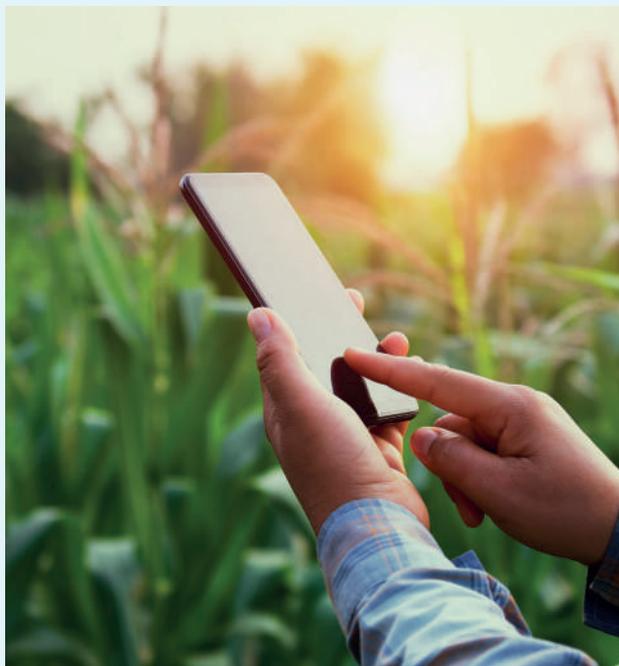
Under the 18th Constitutional Amendment, agriculture amongst other subjects like health and education was devolved from the federal to the provincial level. Provincial governments have since been responsible for policy implementation and service delivery while the federal government continues to operate in a regulatory capacity through the Ministry of National Food Security and Research (MNFSR), coordinating policy formulation, economic coordination, procurement of inputs, and import price stabilization. The State Bank of Pakistan also assists with agriculture development by regulating, providing, and overseeing agriculture financing, while the Securities and Exchange Commission of Pakistan (SECP) regulates insurance companies and non-banking financial companies.

Federal Government

The MNFSR introduced the National Food Security Policy 2018⁷³ that sets a target for agriculture growth rate at 4%, although the country has since achieved an average growth rate of 2 to 3% each year.⁷⁴ In addition to setting agricultural priorities such as climate resilience, it recommends national level flagship initiatives. Technology (digital and IT applications) for agriculture is largely categorised and clubbed as “Information and Knowledge Dissemination” rather than driving a much more pronounced focus by introducing AgriTech as a core driver for transformation in the sector.

Furthermore, policy measures that are relevant to the digitalisation of the agriculture value chain, such as crop-livestock insurance schemes and credit programs, are not marked as areas recommended for digitalisation. Digital and IT applications as per the policy include electronic dissemination of agricultural information, promoting digital innovation, and incorporating ICT for the agriculture extension system.

In addition to the MNFSR’s National Food Security Policy 2018, the Ministry of Planning, Development & Reforms also released a cluster development-based Agriculture Transformation Plan (ATP) Vision 2025⁷⁵ in 2020, which is part of a series of studies across 33 agriculture commodities. To achieve set productivity targets for each commodity, the ATP suggests strategies that include short-term digital agriculture interventions such as establishing e-commerce portals for farmers and creating SMS-based training schemes. However, the short-term interventions in question promote increased market intervention, especially as a high number of agri e-commerce platforms and SMS-based schemes already exist (see Figure 2), rather than setting policy objectives that facilitate the agricultural market. Furthermore, digital agriculture is limited to these mentions and is not perceived as a solution for challenges that the ATP intends to resolve, such as value chain inefficiencies and improving access to financial services and markets.



Notable federal agriculture schemes also include:

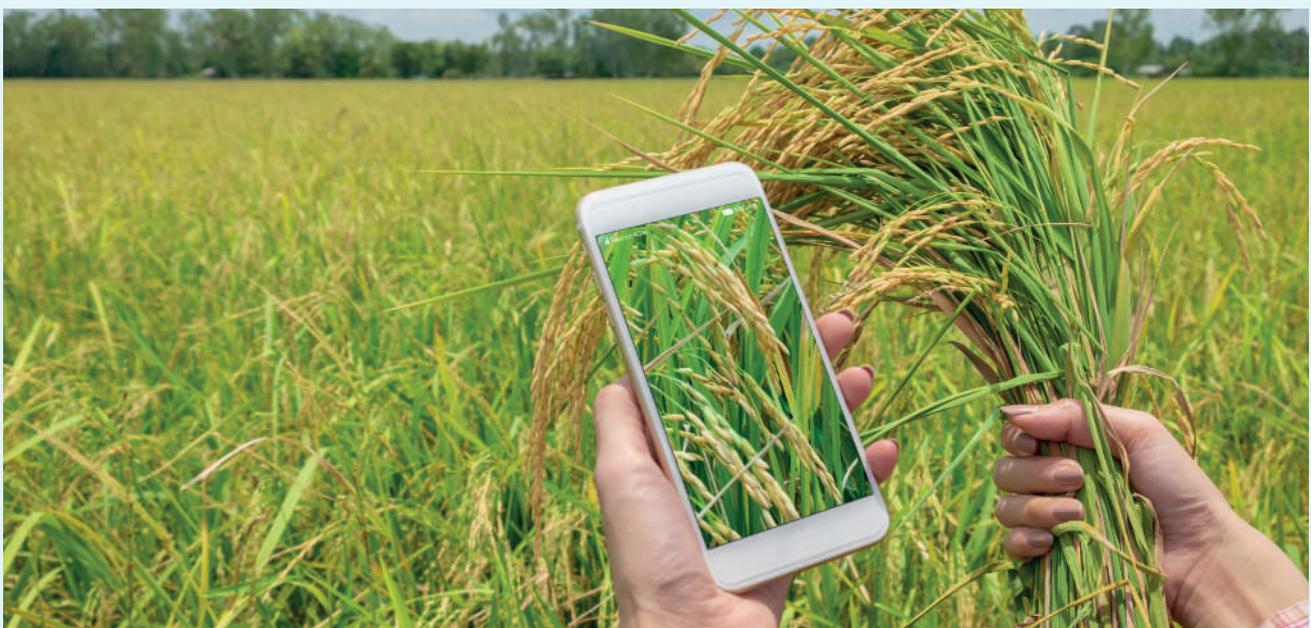
- **Kamyab Kissan:** The Kamyab Kissan Programme, a component of the larger Kamyab Pakistan government initiative, aims to distribute interest-free micro-loans to farmers registered with the National Socio-Economic Registry with proxy means testing (PMT) scores – a way of measuring socioeconomic status – of up to 49. One loan per family is permissible with maximum exposure capped at PKR 2.85 million. An online information portal will be integrated with credit bureaus and the National Database & Registration Authority (NADRA) in order to verify eligibility of beneficiaries.
- **Kisan Portal:** The Kisan Portal was launched in 2021 under the Pakistan Citizen's Portal to resolve farmer complaints. The Portal intends to create an app-based platform for farmers, particularly smallholder farmers, to ensure their complaints are recorded. However, adoption is likely to be minimal given challenges to connectivity in rural areas.

Provincial Governments

The status of agriculture policy formulation and implementation varies from province to province. While Punjab⁷⁶ and Sindh⁷⁷ published updated agricultural policies in 2018 in tandem with the National Food Security Policy 2018, Khyber Pakhtunkhwa's agriculture department is operating as per the KP Agriculture Policy 2014-2024⁷⁸ and Balochistan has recently published a Proposed Agriculture Policy 2021.⁷⁹

Of provincial policies, Punjab's Agriculture Policy 2018 dedicates the most attention towards agricultural innovation and technology. To increase investment and incorporate technology, the policy aims to optimise subsidy programmes through technology-enabled targeting, improve access to finance through mobile money, incentivise SMEs by matching grants, and establish warehouse receipt financing. The Punjab Government has also developed a digitised e-Credit solution, which is integrated with the NADRA database to enable easier access to credit for farmers. Other initiatives include the Mandi mobile app, which records fee collection in agricultural markets.⁸⁰ The Punjab Information Technology Board's (PITB) has also launched an agriculture crop maps system in 2018 using multi-spectral satellite imagery to provide weekly data about yields for 26 different crops.⁸¹

Sindh Agriculture Policy 2018-2030 intends to create targeted subsidy programs linked to the NADRA database in addition to promoting climate-smart technologies such as remote sensory tools, digitisation of agricultural data, and incorporating technology into logistics and supply chain systems. Balochistan's Proposed Agriculture Policy also encourages the development of virtual markets, market information systems, digitised extension services, and a matching grant scheme. While the policy aims to provide access to market, inputs, finance, and knowledge, it does not emphasise use of digital services and solutions to achieve these goals. The KP Agriculture Policy 2014-2024 devotes little attention or detail to the digitalisation of agricultural systems beyond describing a focus on improving technical education and capacity, and developing new technologies for agricultural processes.



While all policies mostly align in outcomes and principles, such as increasing the agriculture growth rate to at least 4% and ensuring that the government refrains from direct market intervention, they do not lay enough emphasis on creating enabling conditions to mainstream AgriTech.

Kisan Card

The PITB launched the Kisan Card Scheme in 2021 to consolidate government schemes, such as smart subsidies for fertiliser, and recipient information to ensure equitable allocation, broadcast information and collect data in a centralised database. To date, the scheme covers 36 districts and serves about 1.3 million farmers in Punjab.⁸² While card adoption has been high, existing issues that impacted established subsidy and incentive schemes continue to persist in Kisan Card usage, such as inputs allocated for Kisan Card owners quickly running out due to sub-optimal management and distribution of resources. While feedback from farmers who have successfully used the Kisan Card has been positive, barriers to use are high for many farmers as a result of the aforementioned factors.



State Bank of Pakistan

The role of the State Bank of Pakistan in supporting agricultural growth is twofold: (i) regulate agriculture financing, and (ii) provide and direct the use of subsidised credit. The overarching strategy that guides the State Bank of Pakistan's approach to mobilising funds for the agriculture sector is the National Financial Inclusion Strategy (NFIS) 2015-2023,⁸³ which aims to expand access to finance across a variety of sectors, including agriculture, in order to achieve inclusive economic growth.

Initiatives outlined under the NFIS and ongoing SBP priorities that link to AgriTech include digitisation of land records. Punjab has digitised 98% of all land records for over 55 million landowners,⁸⁴ while Khyber Pakhtunkhwa intended to digitise 65% of its land records by the end of 2021.⁸⁵ Through the Punjab e-Credit Scheme, automated land records are now accessible through an online portal for participating financial institutions providing interest-free loans to small farmers. By 2020, a total of PKR 62 billion had been disbursed to 890,000 small farmers.

In addition, the State Bank of Pakistan has also launched a scheme for renewable energy. This enables use cases like smart farming and allows households, agricultural clients, and SMEs to avail financing for renewable energy source-based solutions at a markup rate of up to 6%.⁸⁶

The broader aim of the prescribed actions is to help the SBP meet its goal of increasing annual disbursement of agriculture financing to PKR 1.8 trillion by 2023. In fiscal year 2020-2021, Pakistani banks disbursed a total of PKR 1.4 trillion for agricultural credit, while a disbursement target of PKR 1.7 trillion for fiscal year 2021-22 has been announced by the State Bank of Pakistan.⁸⁷ Although this is in line with the NFIS target of PKR 1.8 trillion of annual disbursement by 2023, much of this credit goes to large-scale farmers and agriculture-affiliated companies rather than smallholder farmers who are considered risky credit.

Securities and Exchange Commission of Pakistan

The SECP facilitates AgriTech by overseeing insurance regulation, non-banking financial companies, and venture capital investment. In 2019, the SECP undertook two initiatives that work to enable AgriTech:

- **Regulatory Sandbox Guidelines:** To encourage startups and innovate financial services, SECP issued these guidelines to test innovative products, services and business models in a controlled environment on a limited scale and time period, particularly for areas related to FinTech and thereby agri DFS.
- **Electronic Warehouse Receipt Financing:** The Collateral Management Companies Regulations⁸⁸ were amended to cover financing against stock pledged under electronic warehouse receipts, which allow farmers to exchange crops and transfer titles to improve and standardise storage infrastructure and to reduce food waste. Pakistan's first electronic warehouse receipt was issued in 2021. However, due to high storage costs and the limited scale of production of smallholder farmers, only medium- and large-sized farmers are likely to benefit from this system until it is better established.⁸⁹

3.2.3 Private Sector

The majority of Pakistan's AgriTech growth has been spurred by the private sector, which plays the dual role of creating and scaling AgriTech solutions. Private AgriTech solutions began as mobile agriculture services introduced by mobile operators such as Telenor Pakistan and Telenor Microfinance Bank's Connected Agriculture Punjab Package, a mobile service launched in 2016 to provide digital services through Easypaisa's mobile money platform.

Pakistan's startup ecosystem has shown spectacular growth in the last five years. In 2021 alone, local and international investors poured in capital totalling over USD 350 million,⁹⁰ a higher inflow in 2021 than in the last six years combined. In 2020, Pakistan raised USD 83 million, more than double the funding in 2019. This includes market developments in the AgriTech space, as the startup ecosystem has shown a burgeoning environment for growth of more digital agriculture interventions.

The rise of investment in AgriTech can be credited to the successes of similar business models in other emerging markets, such as recent growth witnessed in B2B digital agriculture services in India.⁹¹ While international investors continue to bet on the digital opportunity in Pakistan despite market risks, establishment of tailored local business models that build on learnings from local and international contexts like India and Kenya make AgriTech startups in Pakistan an attractive choice for early stage investment.

Increased digitalisation and overall tech literacy have also enabled AgriTechs to operate in a more conducive and ripe market, as compared to early AgriTechs like Mandi Express that required more capital to build technology. This enables more recent startups such as Tazah and EasyFresh to gain traction at a faster pace. In all of 2021 combined, however, AgriTech startups raised around USD 9 million, compared to about USD 95 million in the FinTech sector⁹² and USD 202 million in e-commerce, indicating that there is still a long way to go for funding in this space.



ACTIVE AGRITECH STARTUPS IN PAKISTAN

\$ INDICATES THAT STARTUP HAS RAISED FUNDING

AGRI E-COMMERCE

- \$ AgriDunya
- FRUGES FROM EARTH FOR YOU
- \$ Easyfresh
- \$ mandiexpress
- پاک ایگری
- BRIDH FARM
- پ
- AN
- THE F
- \$ Jiye
- فarms to more
- \$ تازه
- AgriMin
- Qurbani App

DIGITAL ADVISORY

- FARMDOAR
- AgriLytics
- Industrus
- پروانگی
- باخترکستان
- GROWTECH
- AgriByt

SMART FARMING

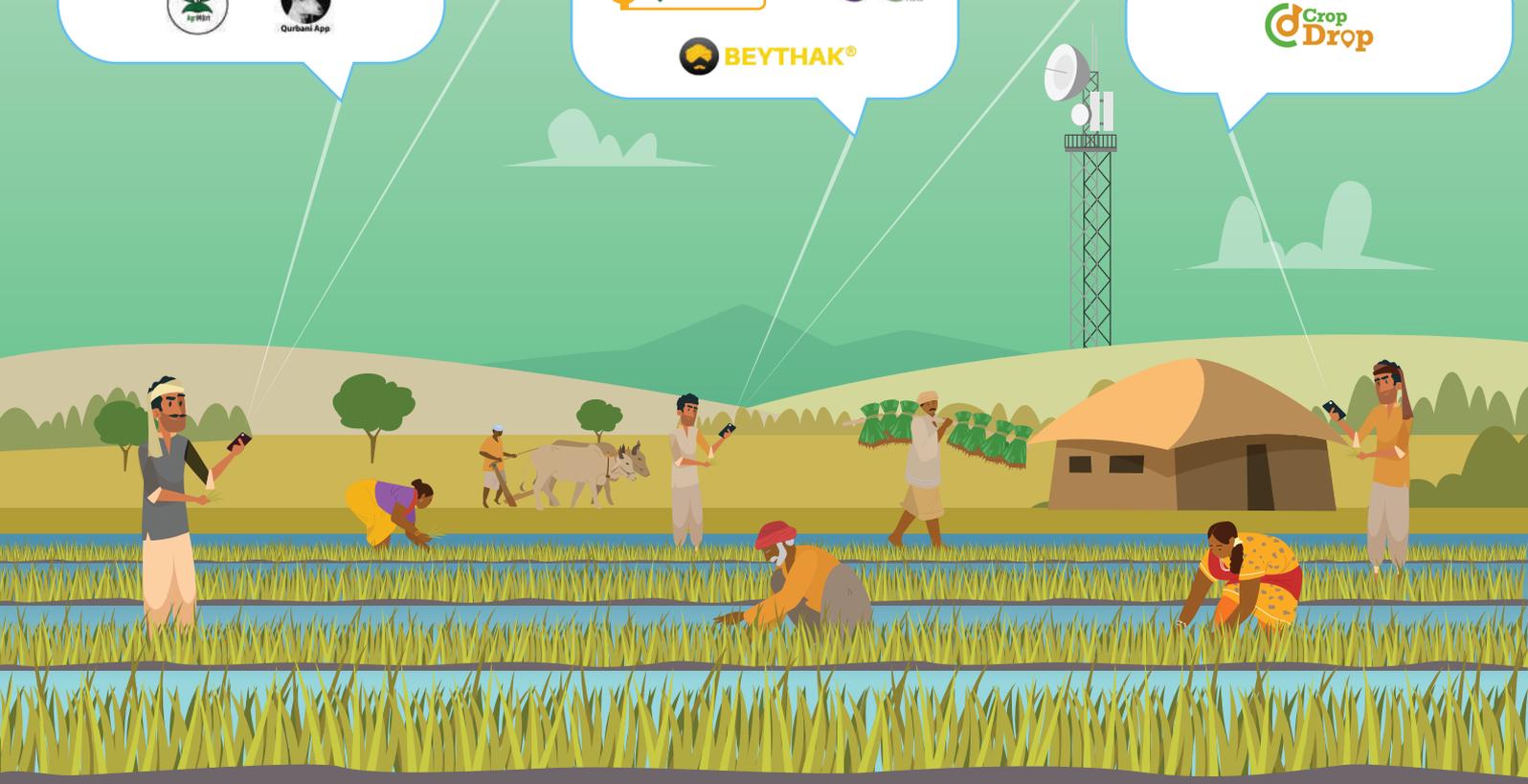
- \$ RemoteWell
- Double Your Crop With crop2X
- RemoteWell
- AVANCE ROBOTICS
- IVS
- \$ COWLAR

AGRI DFS

- \$ ricult
- Reap agr
- BEYTHAK

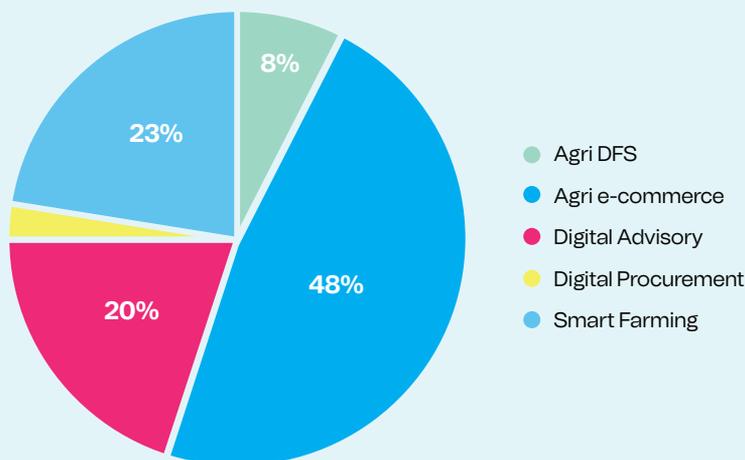
DIGITAL PROCUREMENT

- Crop Drop



As shown in Chart 11, Pakistan's AgriTech startup landscape is characterised by established digital advisory services, growing presence of agri e-commerce platforms, and an increasing number of smart farming solutions. While smart farming solutions like Cowlar – a livestock tracking solution with smart collars – are beginning to establish themselves, challenges to affordability remain a high barrier to deployment of IoT, drone technology, and satellite monitoring in this region.

Chart 11: AgriTech Market Share in Pakistan



Source: invest2innovate, National Incubation Centre

Other large private sector initiatives exclusive of startups and telecommunication companies include local incubators and accelerator programmes like invest2innovate, Telenor Velocity, and Acumen Agriculture Accelerator. Mobile operators continue to play a central role in supporting and enabling AgriTech through both direct interventions, such as Telenor's Khushaal Zamindar services, as well as investment and partnerships with AgriTech startups. In addition, large corporates support AgriTech through their own solutions and suite of companies, such as Fatima Group's Agro-Digital, a subsect company that provides agricultural advisory services and value-added fertilisers to farmers.⁹³

Advisory

Khushaal Zamindar

Khushaal Watan (Prosperous Country) is Telenor Pakistan's digital agriculture suite, which consists of multi-channel (SMS, IVR and Mobile App) offerings that cover advisory, health and crop insurance, telehealth for livestock, digital helpline for female farmers, and agriculture entertainment. Of its 16 million monthly users, 10 million belong to its flagship service, Khushaal Zamindar. Launched in 2015, the service covers information regarding weather, crop and livestock advisory is available through SMS and IVR channels. IVR channels also allow customers to access live shows where experts answer farmers' questions on air and free of charge. Khushaal Zamindar also caters to use cases such as legal advisory, female-centric content, and mandi rates. To attract potential users, business intelligence is used for outbound marketing to explain offerings. The service was extended with the Khushaal Watan app in 2021 to provide localised agricultural information and connect farmers to experts and veterinarians through audio and video calls.

Bakhabar Kissan

Launched in 2016, Bakhabar Kissan provides tailored information and advisory services by connecting farmers to agricultural experts for advice on optimising their crop yield, better farm management practices, weather, pest, and other advisory. The company's online application supplies market information, weather forecasting, videos, and a section dedicated to agriculture updates and government schemes for farmers to access. Information is available through SMS and IVR channels, providing region specific timely information regarding pests, seed, harvesting and sowing, and other on-demand information.⁹⁴ The AgriTech receives 12 million IVR calls each month and has a total 6 million call centre users.

Agri E-Commerce

Tazah Tech

Tazah is an online B2B marketplace launched in 2021, connecting farmers to buyers and sellers through a tech-enabled operating system by sourcing produce directly from farmers, processing it at its warehouses, and shipping to businesses. The platform also functions as a financier providing working capital to farmers and enabling them to invest in equipment and inputs. Tazah aims to minimise agriculture supply chain discrepancies by providing streamlined logistics infrastructure and outsourced warehousing.⁹⁵ The digital marketplace provides farmers an alternative option for selling produce, offering greater transparency on produce market prices and minimised food wastage through a more efficient supply chain. In late 2021, the startup raised USD 6.5 million in Pakistan's largest pre-seed funding. Tazah caters to about 300 small- to medium-sized sellers, gaining a traction of 1,500 customers on a day-to-day basis out of a total customer base of 6,000.

Agri DFS

Ricult

Ricult has been providing analytics-based digital financial services to farmers in Pakistan and Thailand since their launch in 2016. Using farmer profile data, Ricult creates tailored financial products for farmers to increase financial access, match farming cycles, and improve risk management for financial institutions. Through their products, Ricult has assisted farmers in Pakistan and Thailand with USD 500,000 worth of financial support.⁹⁶ Over time, they have expanded into analytics-based advisory offerings that include weather, livestock and farm advisory via satellite imagery, machine learning, and farm measurement tools. These products have engaged almost 60,000 users and analysed 5 million acres using satellite imagery across both countries.

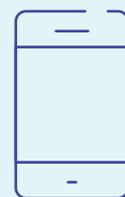
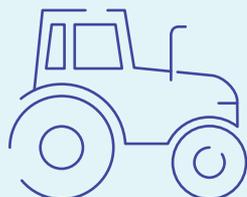
Startup Enablement

Telenor Velocity Accelerator

Telenor Velocity was launched to support growth stage startups in product development, go-to-market strategy, and an opportunity to co-sell with Telenor's specialists. This includes access to Telenor's 49 million customers in Pakistan, My Telenor App's 10 million users, and facilitating startups with digital marketing, coaching from experts, and analytics for better segmentation.⁹⁷

Pak Agri Market was scaled through the accelerator in 2018. It is an online marketplace for vendors to supply agricultural inputs with the larger goal of digitising small retailers dealing in agricultural produce. Telenor's accelerator helped pilot Pak Agri Market's digital vendor concept and assisted its rollout during a time when Pakistan had low appetite for AgriTechs. The startup was supported through development of a separate IVR, selling Pak Agri Market's informational services and white labelling its solution. With the assistance of Velocity, Pak Agri Market was able to scale to 120 tehsils of northern and central Punjab, which resulted in a revenue growth of 100x.

To improve accessibility, Pak Agri Market provides services and resources in Urdu and Saraiki with minimal presence of English on their channels. With assistance from Velocity and the National Incubation Centre (NIC), Pak Agri Market was able to grow, particularly during the Covid-19 pandemic, which more than doubled the number of registered vendors. During this time, the website also gained up to 20,000 users.

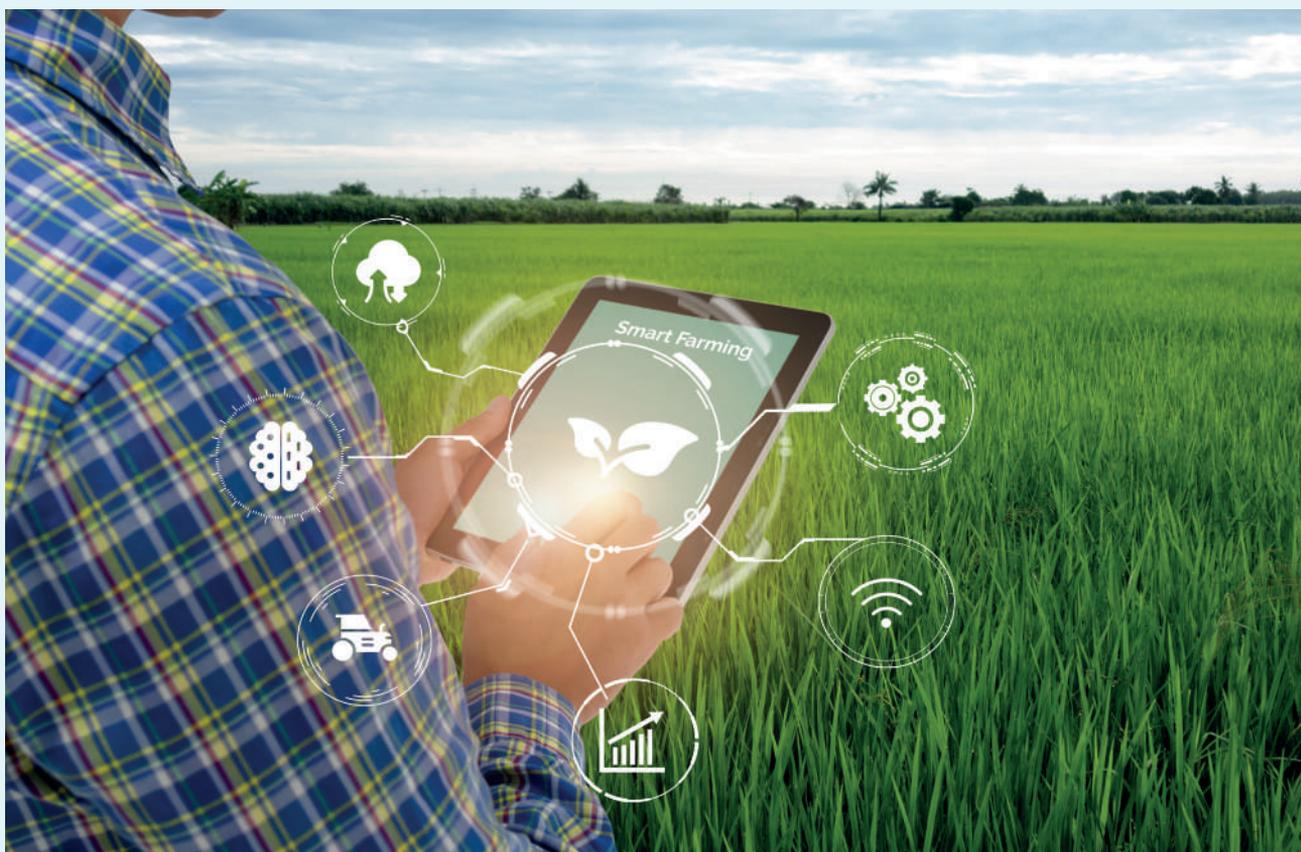


Uptake of services that cater to farmers, such as marketplaces and advisory, has seen growth in the recent years. An important contributor to this growth is the general level of accelerated digital adoption during Covid-19, which helped double user bases for some AgriTechs. However, for widescale impact, inequities in digital access and readiness must be addressed. App-based AgriTech services that rely on smartphone ownership, broadband connectivity, and digital literacy witness less usage than SMS- and voice-based services. For instance, while Bakhbar Kissan's IVR system receives 12 million calls each month, their app has received only 400,000 downloads.

While farmers with larger holdings are more resilient and have low risk appetite to shift away from traditional models and practices, it is observed that smallholder farmers are more risk-seeking and willing to try new services with digital interfaces due to the precarity of their crops and livelihoods. While building trust in digital services and platforms will require consistent efforts, supply side development to provide affordable solutions in the market that are adequately tailored to the unique needs of farmers e.g., their soil and climate conditions will be required to demonstrate a strong value proposition to boost demand. Advisory offerings are often behind the pace of rural needs, resulting in outdated, irrelevant, or inaccurate information. For example, an advisory app may recommend a certain seed to a farmer that increases yields, but a smallholder farmer may not be able to source or afford the seed variety and would require further information and/or enablement to implement such advice.

AgriTech services tend to pass on service costs to farmers as a part of their monetisation plans, further slowing uptake. The AgriTech vertical, despite the opportunity set, will require time to adequately solve challenges faced by the sector, such as those of informal financial markets. For instance, some digital marketplaces in Pakistan have no choice but to buy from large farmers or intermediaries, rather than sourcing directly from smallholder farmers who are already in agreement with these intermediaries to sell their products.

To meet the needs of the agriculture sector, AgriTech services must grow. The private sector has been a crucial player in expanding Pakistan's AgriTech footprint and integrating technology into the farmer's everyday life. AgriTechs are finally receiving their spotlight moment in Pakistan. Despite positive trends, significant opportunities exist for the ecosystem to grow and support existing and new entrants. To successfully address challenges in the agriculture value chain through technology, private agriculture solutions need to be cultivated through increased capital, government support, and innovation cycles.



4 | ROADMAP FOR THE FUTURE



Global evidence around AgriTech has established impact on productivity, profitability, climate resilience, financial inclusion, and female and youth empowerment. The case for digitalisation in Pakistan's agriculture value chain can generate a multiplier effect through trickle downs at the macro, meso, and micro layers. At the centre of agricultural transformation is the empowerment of Pakistan's 25 million agricultural workers, whose livelihoods, and economic and social progression can usher in a much-needed domestic growth wave.

The challenge set faced by the agriculture sector in Pakistan is multi-pronged with intersections across political, economic, and administrative lines. The confluence of economic pressures, digitisation, and demographic factors creates a unique window of opportunity to leverage the role of technology in transforming the fundamentals of the agriculture sector. While a range of other reforms will be required to realise the true potential of agriculture, technology and digitalisation can certainly offer a catalytic boost to recentre focus on improving outcomes in the short, medium, and long term.

There is a sizeable opportunity for local, home-grown solutions that can serve Pakistan's unique agricultural needs. Cellular operators have helped pioneer some of Pakistan's earliest AgriTech services. Now, they can play a more engaging role by providing support to AgriTech startups with different value propositions, who can leverage the available infrastructure, digital assets, and enabling platforms to position themselves across the agriculture value chain. Such complementing linkages can inculcate a more entrepreneurial approach to problem-solving. This can be further supported by existing startup activity, investment rounds and market shaping developments like exits that boost investor confidence. Value creation must be prioritised by building solutions that are demand-driven rather than supply-focused. Without addressing the problems of smallholder farmers, i.e., 75% of the farming population, structural challenges to agriculture productivity will continue to persist.

A coherent and well-conceived plan with strong execution can help spur AgriTech. While the overall business and innovation environment in Pakistan affects all sectors and consequently AgriTech, focused interventions can help boost AgriTech faster. The recommendations below aim to lay out a path for this transformation.

Define and Establish the Normative Value and Positioning of AgriTech

Recognition of AgriTech as an intersectional element of policy and implementation will require the development of a national AgriTech framework that is embedded in policies and action plans at the federal and provincial levels. This framework can guide subsequent policy and administrative instruments that identify key, actionable tech-based interventions. The framework should include components like principles, priority outcomes, enablers and drivers, resource allocation, delivery mechanisms, engagement, behaviour change, and regulation and monitoring.

Ministry of National Food Security and Research
Provincial Agriculture Departments
Multilaterals and Bilaterals

Enhance Public Sector Digitisation

The established scale and scope of public service structures for agriculture – R&D, extension, machinery, field staff, regulation of inputs, crop estimation – should be leveraged to facilitate awareness, understanding, and adoption of digital services. This can be done by:

- i. Rapid digital transformation of government systems for data management, service delivery, beneficiary engagement
- ii. Working with private service providers to enable adoption and mainstreaming of services and platforms that help address gaps in public service delivery

Proposed Initiatives Include:

- i. Creation of a national supply and demand management system which reduces information asymmetry and can support matching crop production and consumption in real/near-real time to minimise waste manage pricing optimise trade.
- ii. Digitisation of extension services for proactive and timely alerts and advice based on crop cycles and local conditions.
- iii. Digitisation of public subsidy, credit, inputs, and other schemes which connect to a central farmer profile database to allow use of relevant data within and outside government and to create digital identities for farmers for use in economic and financial use-cases.
- iv. Development of a national agriculture open data portal to enable the generation and use of big data for sophisticated analytical support to decision-making, problem-solving, and market-sizing.
- v. Digital markets and automation of procurement processes to improve transparency, reduce information asymmetry, and arbitrage.

Ministry of National Food Security and Research
Provincial Agriculture Departments
National and Provincial IT Boards/Departments
Finance Division and Departments
State Bank of Pakistan

Proliferate Fintech to Support Agri DFS

Financial autonomy of farmers, in particular small farmers, could be a lynchpin to unlocking productivity, market-informed choices and redistribution of value for farmer prosperity. Offering alternatives to intermediaries as financiers and decision influencers through enabling credit, insurance, and other financial services can unlock significant value in agriculture. The FinTech boom in Pakistan should be channelled to develop solutions for the agri DFS and support go-to-market execution that leads to the adoption of such services with the associated support structures to improve productivity and access to markets. A focus on Shariah-compliant financial services/solutions by FinTechs can create an additional appeal for farmers to explore such options. In addition, as SBP payments gateway Raast continues to integrate use cases, there is an opportunity for the system to be a core enabler for pushing agriculture-specific use cases. Special attention should be given to agri DFS in terms of Raast integration. Furthermore, agricultural lending targets should be targeted so that 50% of the lending target is dedicated to smallholder farmers.

State Bank of Pakistan
Pakistan Fintech Network
Fintech Association of Pakistan

Enable Farmers through Digital and Financial Access

Enabling farmers to be able to effectively utilise AgriTech service offerings requires a four-pronged concerted effort:

- i. Improve connectivity in rural areas by expanding 4G footprint for mobile broadband coverage and higher quality of service that supports bandwidth-intensive use-cases. This will require more spectrum at affordable pricing and an aggressive fibre optic rollout to connect towers and clusters in rural areas
- ii. Increase smart device penetration to allow farmers to use connectivity and adopt sophisticated use-cases that require app-based interfaces e.g., e-commerce, DFS. Rationalisation of levies on smartphones, increased domestic production and targeted subsidies through integrated programmes where device and connectivity enablement are packaged with interventions can support increased penetration.
- iii. Increase digital and financial literacy to enable farmers to engage productively and effectively with available digital solutions. Existing financial literacy programmes can be adapted to local languages and contexts at a regional level, and targeted digital and AgriTech literacy and awareness programmes with experiential learning components, demo days, and guided trial-runs can help fast-track adoption in farmers.
- iv. Development of integrated service offerings for females that are tailored to addressing challenges specific to the rural context e.g., female call agents on helplines, health and technical advice etc. Access to AgriTech services can be prioritised through such services to increase involvement in use-cases like financial services, markets and transactions which typically rest with male agriculture workers.

Mobile network operators
Ministry of IT & Telecom
Universal Service Fund
Ministry of National Food Security and Research
Provincial Agriculture Departments
Multilateral and Bilateral Organisations

Strengthen the Startup Ecosystem with Vertical-specific Support

The role of incubators and accelerators has helped startups strengthen their product, positioning, secure investment, and execute strong go-to-market. AgriTech focused incubators and accelerators can be established through cross-sectoral linkages which include agriculture universities, training institutes, technology/telecom service providers, and research institutes. Design, operation and governance of such platforms should be rooted in deep engagement with farmers and a solution-centric approach to tackle challenges faced in the agriculture value chain.

Ministry of IT & Telecom
Ignite
Special Technology Zones Authority
Ministry of National Food Security and Research

The recently announced Pakistan Technology Startup Fund can be an encouraging platform to drive focus on AgriTech startups that offer disruptive and scalable solutions for the local market.

Establishment of Special Technology Zones (STZs) across Pakistan offers another avenue for exploring synergies with agriculture clusters. Exploring an AgriTech STZ could offer an interesting model that could be extended through local partnerships amongst provinces.

Provincial Agriculture
Departments
Technology/Telecom Service
Providers

Align the Ecosystem and Reposition Existing Actors

Intermediaries are an essential node which drive the agriculture value chain from financing and inputs to market access. In many cases, they play a role that is unserved by formal actors and entities, and guarantees subsistence farming for millions of households. Furthermore, a public platform that aggregates supply will not be possible without data provided by intermediaries. While structural changes like minimizing the role of intermediaries can take decades, repositioning them to be integrated in the AgriTech value chain and become enablers that benefit from and drive trickle down dividends through technology could be a more viable proposition that helps realign the ecosystem to achieve better outcomes. Agri businesses that provide inputs or purchase produce and dairy can similarly be positioned in the tech-driven value chain to play a pivotal role in mainstreaming digital adoption for mutually beneficial roles amongst all actors.

Ministry of National Food
Security and Research
Provincial Agriculture
Departments
Intermediaries and agri
businesses
Business and Farmer
Associations

Expand Pakistani AgriTechs Across the Globe

Similarities in context among emerging agriculture-focused economies can enable expansion of Pakistan's AgriTech footprint at a regional and global scale. Established service providers can mature business models, solutions, and platforms in the domestic market and use these learnings to export services and/or enter new markets that can capitalise on the learning curve already achieved locally. This can complement the ongoing IT and ITeS export growth rally. Efforts should be focused on identifying markets that have similar contexts and can use services and solutions from Pakistan. Proactive engagement to conduct roadshows and growth opportunities should be prioritised to further boost IT exports that can generate critical foreign exchange. Pakistan's diplomatic missions can be engaged to facilitate such exchanges and market access.

Ministry of IT & Telecom
PASHA
Board of Investment
Ministry of Commerce
Ministry of Foreign Affairs

Drive Adoption through Behavioural Change and Insights

Adoption of technology, especially when it disrupts legacy methods that have been followed for decades, is driven by behavioural rather than transactional drivers. Rigorous and robust programmes to understand behaviours, drivers, inhibitors, and adoption cycles and curves should be pioneered and embedded in public and private agriculture programmes, deployments, and interventions. Alignment of public and private sector approaches towards AgriTech are requisite to establishing trust in the market, particularly for farmers presently dependent on government services. Federal and provincial governments must expand communication with farmers and align messaging with that of private solutions. Private services/solutions should receive as much attention as public sector/development partner programmes to generate such insights and link them to policy and implementation decision-making. A national unit for behavioural insights that is focused on agriculture and technology can be established at MNFSR to coordinate and lead a representative national agenda.

Ministry of National Food
Security and Research
Provincial Agriculture
Departments
Business and Farmer
Associations
Multilateral and Bilateral
Organisations
Academia, Think Tanks and
Civil Society

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