

Transforming Pakistan's Agriculture and Food Systems in an Age of Disruption: AI for Regenerative and Climate-Smart Farming

Agriculture and food systems in Pakistan are increasingly exposed to multiple and interconnected pressures. Growing climate change and extreme weather events are making agricultural planning and production more uncertain and complex. At the same time, growing water scarcity, declining soil organic matter levels, and rising input and energy costs are placing further pressure on agricultural productivity and farm profitability. These challenges are not only experienced directly by farmers but also have wider implications for the food sector, agribusinesses, consumers, and policymakers across the food system. Addressing these pressures requires a systemic transition towards regenerative and climate-smart agriculture, supported by sustained investment, institutional capacities, and the adoption of appropriate digital and technological innovations.

Regenerative agriculture places the health and long-term productive capacity of agricultural ecosystems at its core. It seeks to restore soil health, improve the efficiency of water and input use, conserve biodiversity, and strengthen the resilience of farming systems through practices such as minimum or reduced tillage, cover cropping, intercropping, agroforestry, composting, and the incorporation of crop residues into the soil. In parallel, climate-smart agriculture provides a broader framework for addressing the interrelated challenges of agricultural productivity, climate adaptation, and greenhouse gas emissions. While the two approaches differ in their conceptual frame, however, they overlap in their environmental practices and adaptation and can be further strengthened through improved extension systems that provide farmers with timely, reliable, and context-specific information.

This is where emerging digital technologies can play an important enabling role. Artificial Intelligence (AI), satellite imagery and remote sensing, Internet of Things (IoT) sensors, and digital agricultural advisory services can generate timely, field-level information to support decision-making on irrigation, crop health, soil conditions, weather-related risks, pest and disease management and input use. Across the wider agricultural value chain, AI-enabled applications can also strengthen production forecasting, supply chain traceability, market intelligence and risk management.

However, the transformative potential of these technologies is not automatic. A [2025 World Bank](#) report highlights the importance of enabling conditions, including digital infrastructure, effective governance, relevant skills, and inclusive access, for AI to generate meaningful benefits for (small-scale) farmers. In Pakistan, this implies the need for reliable and interoperable agricultural data, affordable and accessible digital connectivity and services, appropriate digital skills among farmers and extension personnel, responsible and transparent applications of AI, and viable business models that can serve small- and medium-scale farmers rather than primarily benefiting larger commercial producers.

The challenge is to connect regenerative, climate-smart and AI-enabled agriculture in one coherent transformation of Pakistan's agriculture and food systems. For instance, crop residue shows why these agendas need to come together. Pakistan generates an

estimated [112 million tonnes of agricultural residue](#) annually, including wheat and rice straw, rice husk, sugarcane trash and bagasse, and cotton and maize stalks. A substantial share is still burned in the open, contributing to smog and greenhouse gas emissions while destroying valuable organic matter. Yet these residues need not be treated as waste. Retained as mulch, used as livestock feed or converted into industrial fuel, they can become valuable economic resources while supporting soil health and reducing environmental damage.

Pakistan already has practical examples of turning agricultural waste into economic value. [Nestlé Pakistan](#) has introduced regenerative farming practices on more than 125 farms across Punjab, including composting, intercropping, cover crops, agroforestry, minimum tillage and the use of crop residues as mulch rather than burning them. Its USD 4.5 million biomass steam plant in Sheikhpura, launched in August 2026, takes this approach a step further. Designed to use approximately 72,000 tonnes of agricultural residue annually, the plant can generate 30 tonnes of steam per hour for industrial operations, reducing dependence on fossil fuels and potentially cutting carbon dioxide emissions by an estimated 24,000 tonnes a year. Examples like these show that Public-Private Partnerships (PPPs) can do wonders for wider adoption: scaling regenerative and climate-smart practices, building markets for crop residue, strengthening farmer skills, developing financing that suits smallholders, coordinating across federal and provincial institutions, and getting relevant technology and research to farmers.

Given this backdrop, this session will address the following key questions:

- What would it take to make regenerative, climate-smart and AI-enabled agriculture work at scale in Pakistan? In particular, which policy, institutional and financial measures would do the most to move these practices from demonstration plots to farms across Pakistan?
- Where are AI, remote sensing, IoT and digital advisory services already useful to farmers in Pakistan, and what holds back wider use: data, connectivity, cost, trust or skills?
- Which financing mechanisms can bring public, private and development finance together for regenerative practices, climate-smart technologies, renewable energy and AI-enabled services?

It will bring together policymakers, development partners, private sector leaders, agritech innovators and researchers to identify workable pathways for scaling solutions, mobilising investment and strengthening collaboration.

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