

Harnessing Technology for Sustainable Agriculture: A Path to Prosperity

Endowed with fertile land and a rich agricultural heritage, Pakistan has extensively relied on its agrarian sector as a primary source of livelihood for millions of its citizens. Despite its historical significance, the agricultural landscape of Pakistan is facing formidable challenges even in this 21st century. With a rapidly growing population, dwindling natural resources, and the adverse impacts of climate change, ensuring food security has become an urgent priority for the nation. In this context, the modernization of agriculture emerges as a critical pathway towards sustainable development, economic prosperity, and enhanced food security in Pakistan.

The Need for Modernization

Agriculture serves as the backbone of Pakistan's economy, employing over 40% of the workforce and contributing approximately 18.5% to the country's GDP (World Bank, 2020). Despite its significant contribution, the sector grapples with persistently low productivity levels, outdated farming practices, inadequate infrastructure, and limited access to credit and technology. According to the Pakistan Economic Review of 2023, the agriculture sector received around PKR 1.22 trillion in development expenditures. This highlights the government's recognition of the agricultural sector important as well as need for investment for modernizing this sector. Addressing these challenges requires a comprehensive approach that leverages technological innovation, sustainable practices, and strategic investments to propel the agriculture sector.

Embracing Technology and Innovation

Modernizing agricultural sector entails harnessing cutting-edge technologies and innovative practices to optimize resource utilization, enhance productivity, and mitigate environmental impact. Precision agriculture outlines the use of imagery satellite, drones, and sensors. This enables farmers to make data-driven decisions regarding irrigation, fertilization, and pest management, thereby maximizing crop yields while minimizing inputs. Additionally, biotechnological advancements, such as genetically modified crops with enhanced resistance to pests and diseases, offer the potential to boost agricultural productivity and resilience in the face of changing climatic conditions.

In Pakistan, initiatives like the Prime Minister's Agriculture Emergency Program exemplify the government's commitment to promote modern farming techniques (e.g. precision agriculture, hydroponics, vertical farming, etc.) through the provision of subsidized machinery, improved seeds, and training for farmers (Ministry of National Food Security & Research, Government of Pakistan, 2022). Furthermore, public-private partnerships and collaboration with international organizations are essential for facilitating technology transfer, knowledge exchange, and capacity



Author

Hakim Ali Jatoi, FCMA
Owner, Hakim Agri Farms & Secretary
Karachi Branch Council of ICMA

Co-Author

Arshad Ahmed Ghumro, ACMA
Manager Internal Audit,
Pakistan State Oil Company Ltd.

building within the agriculture sector. By embracing innovation and fostering an enabling environment for technology adoption, Pakistan can unlock the full potential of its agricultural productivity and competitiveness on the global stage.

Improving Infrastructure and Access to Resources

Investment in infrastructure is critical for modernizing agriculture and overcoming logistical constraints that hinder the efficient movement of agricultural inputs and outputs. According to ongoing efforts to enhance irrigation systems, storage facilities, and transportation networks are essential for reducing post-harvest losses, improving market access, and ensuring food security. Additionally, access to credit, insurance, and markets plays a pivotal role in empowering farmers, enabling them to invest in modern inputs, adopt new technologies, and manage production risks effectively. By strengthening rural infrastructure and expanding financial services, Pakistan can enhance the resilience and competitiveness of its agriculture sector while promoting inclusive growth and poverty reduction.

Pakistan's water crisis has been exacerbated by inefficient irrigation practices, rapid urbanization, and climate variability. According to the Pakistan Economic Review of 2023, per capita water availability has declined from 5,000 cubic meters in 1951 to less than 1,000 cubic meters in recent years, underscoring the urgent need for sustainable water management strategies. Adoption of water-saving technologies such as drip irrigation, laser land leveling, and canal lining can improve water-use efficiency, minimize wastage, and enhance crop yields. Furthermore, investments in water storage infrastructure, rainwater harvesting, and watershed management are essential for replenishing groundwater resources, mitigating flood risks, and ensuring long-term water security for agricultural and domestic use.

Progressive Farming

Progressive farming, also known as modern or smart farming, integrates technology, data analytics, and sustainable practices to optimize crop production, minimize resource use, and enhance profitability. Recent statistics indicate a growing trend towards the adoption of progressive farming methods in Pakistan. According to a report by the PBS 2024, the area under precision agriculture techniques such as drip irrigation and laser land leveling has increased by 15% in the past year. Also, the use of digital farming tools, such as mobile applications for crop monitoring and yield forecasting, has gained popularity among progressive farmers, enabling them to make informed decisions and maximize returns on investment.

Corporate Farming and its Role in Modernization

Corporate farming has been a contentious topic in agricultural sector in many agricultural discussions, holds the potential to significantly contribute to the modernization and efficiency of agriculture in Pakistan. By allowing large-scale corporate entities to invest in agriculture, Pakistan can leverage their resources, expertise, and technology to transform the sector. Corporate farms can introduce advanced farming practices, such as mechanization, digitalization, and precision agriculture, to enhance productivity and optimize resource utilization. Moreover, corporate farming can facilitate the integration of smallholder farmers into value chains, providing them with access to markets, finance, and technical assistance. However, it is essential to ensure that corporate farming practices are aligned with the principles of sustainable agriculture, environmental stewardship, and social responsibility. By striking a balance between corporate interests and the needs of small-farm holders, Pakistan can harness the potential of corporate farming to modernize its agriculture sector while promoting inclusive growth and food security.

Climate Smart Agriculture

Climate change poses a formidable threat to agriculture, exacerbating extreme weather events, altering precipitation patterns, and increasing the frequency of pest and disease outbreaks. Climate-smart agricultural practices offer a holistic approach to building resilience, adapting to changing climatic conditions, and mitigating greenhouse gas emissions. Crop diversification, agroforestry, and conservation agriculture promote biodiversity, soil health, and carbon sequestration, thereby enhancing the resilience of agroecosystems to climate-related stresses (Food and Agriculture Organization, 2019). The climate-resilient crop varieties, weather-based insurance schemes, and early warning systems help farmers anticipate and mitigate the impacts of extreme weather events. While ensuring the continuity of agricultural production and safeguarding food security.

Promoting Sustainable Practices

Sustainability is one of the key features for modernizing agriculture sector encompassing ecological integrity,

economic viability, and social equity. Organic farming, integrated pest management, and soil conservation practices promote soil health, biodiversity, and ecosystem resilience while reducing reliance on synthetic inputs and minimizing environmental pollution. Moreover, agroecological approaches, such as mixed cropping, crop rotation, and intercropping, enhance resource use efficiency, improve nutrient cycling, and foster ecological balance within agricultural landscapes. By promoting sustainable practices and incentivizing environmentally friendly farming methods, Pakistan can safeguard its natural resources, preserve biodiversity, and ensure the long-term viability of its agriculture sector.

The Path to Prosperity

Modernizing agriculture in Pakistan is not just to increase the crop yields or ensuring food security; it is about laying the foundation for long-term prosperity and sustainable development. By embracing innovation, harnessing technology and prioritizing sustainability, Pakistan can transform its agricultural sector into a dynamic engine of growth, creating employment opportunities, reducing poverty and fostering economic resilience.

Conclusion

Modernizing agriculture is imperative for Pakistan to achieve sustainable development, enhance food security, and alleviate poverty in the 21st century. The government, in collaboration with stakeholders from the public and private sectors, academia, and civil society, must prioritize investments in infrastructure, research and development, and policy reforms to create an enabling environment for agricultural modernization. By harnessing the collective potential of its agricultural sector, Pakistan can realize its vision of a more resilient, inclusive, and food-secure future for all its citizens. The time to act is now, for the journey towards a modern, resilient and inclusive agricultural sector begins today.

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About the Authors: Mr. Hakim Ali Jatoi, Author, is a Fellow Member of ICMA and the owner of Hakim Agri Farms. Additionally, he currently serves as the Secretary of the Karachi Branch Council of ICMA.

Mr. Arshad Ahmed Ghumro, Co-Author, is an Associate Member of ICMA and currently works as the Manager of Internal Audit at Pakistan State Oil Company Limited. With approximately 15 years of experience in finance and internal audit, he brings valuable expertise to the field.