ISSUE BRIEF

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CULTIVATING AGRO-SUSTAINABILITY IN PAKISTAN

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Climate change is our leading global issue; therefore, it has become imperative to reduce or eliminate any practices that can exacerbate environmental damage. It can eventually increase the rate of erosion and turn fertile land turns into arid, and ultimately useless, soil.

Agriculture is the backbone of Pakistan's economy. It makes up for 24% of the Gross Domestic Product (GDP) and half the employed labour of the country is working in this sector. Most importantly, it is the largest source of foreign exchange income for the developing country.[1]Pakistan faces a rapidly growing population and is under immense pressure to increase its food production to keep up with domestic demand, as well as export demand to keep its economy afloat. To ensure a stable and sustainable future, it is imperative to overhaul agricultural methods and embrace crop diversification. Sustainable farming, as a solution, centres on soil enhancing health, and maintaining its natural state to prevent erosion and desertification. It also includes using water resources efficiently and minimizing pollution through the use of fertilizers and pesticides. Furthermore, sustainable farming also includes preserving the biodiversity of plants and insects that are essential in maintaining a healthy ecosystem.[2]

1 "Agriculture Statistics," *Pakistan Bureau of Statistics,* https://www.pbs.gov.pk/content/agriculture-statistics#:~:text=%E2%80%8BAgriculture%20constitutes%20the%20largest,source%20of%20foreign%20exchange%20earnings

2 "What Is Sustainable Agriculture?" *Union of Concerned Scientists,* March 15, 2022, https://www.ucsusa.org/resources/what-sustainable-agriculture

For countries like Pakistan, including sustainable agriculture practices is vital for a stable future. With a rapidly growing population and an economy heavily dependent on agriculture, Pakistan can benefit greatly from the developing technologies and methods that can increase food production in an efficient and environmentally stable method. There are several practices to shift towards sustainable cultivation of crops:

1. The rotation of crops is done by planting different types of crops rather than repeatedly growing one type on one patch of land. This also includes intercropping, which is the plantation of different types of crops in one space at the same time. Through this, soil health is improved can be maintained for longer and will reduce the need for pesticides.

2. Organic farming is a particularly well-known method of sustainable farming. Synthetic pesticides, herbicides and fertilizers are avoided in favour of compost, cover crops and biological pest control that could ensure soil fertility and pests.[3] This also reduces water pollution from chemical runoff. Pakistan Organic Farms are recognized internationally for their practices and are the leading exporters of organically grown basmati rice, and other crops like cotton and wheat, since 2002.[4]

3. Agro-forestry is a dynamic solution to increase social, economic, and environmental advantages for land users. It refers to land management that involves the cultivation of woody perennials (trees, shrubs) at the same time with crops or even livestock.[5] The aim is to create an environment that can benefit different components. This could be done through alley cropping where trees are planted in rows between crop rows.[6]

4. Another method under agro-forestry is silvopasture which is the integration of trees and grazing of livestock on one land. This diversifies farm income and improves livestock health.[7]

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3 Ashoka Gamage, Ruchira Gangahagedara, Jeewan Gamage, Nepali Jayasinghe, Nathasha Kodikara, Piumali Suraweera, Othmane Merah, "Role of Organic Farming for Achieving Sustainability In Agriculture, Farming System," *Elsevier B.V.,* April, 2023, https://www.sciencedirect.com/science/article/pii/S2949911923000059

4 "Leading Organic Basmati Rice Exporters in Pakistan," *Pakistan Organic Farms, 2018, https://pakof.com/*

5 "Agroforestry," *Food and Agriculture Organization of the United Nations,* October 23, 2015, https://www.fao.org/forestry/agroforestry/80338/en/

6 "What Is Alley Cropping?" *U.S. Department of Agriculture, National Agroforestry Center,* January, 2012, https://www.fs.usda.gov/nac/assets/documents/workingtrees/infosheets/WT_Info_alley_cropping.pdf

7 "Silvopasture in the USA: A Systematic Review of Natural Resource Professional and Producer-reported Benefits, Challenges, and Management Activities," *Elsevier,* March 1, 2022, https://www.sciencedirect.com/science/article/pii/S0167880921005223?via%3Dihub

5. The Windbreaks method where trees are used to protect crops from strong wind is a method under agro-forestry as well. These methods improve soil quality by reducing erosion and increasing organic matter, enhance biodiversity, and increase carbon sequestration.

6. Cover crops and green manure practices in sustainable cultivation that focus on improving soil health. Cover crops are used to provide shade to the soil when there is no cash crop growing. The roots of these plants reduce soil erosion and keep the topmost part of the land fertile. They also reduce weed growth which diminishes the need to use harmful chemicals. Green manure is adding certain crops into the soil to increase fertility and add structure. This is a better and healthier alternative to chemicals and other synthetic inputs.[8]

Technological Innovations for Sustainability

Artificial Intelligence (AI) has been used in technologies like sensors embedded in drones and analysis tools which can assist in water management and other inputs like fertilisers, pesticides, and herbicides. This has granted greater control in the hands of farmers as to how much of their resource is used at a given time on their land. This is also known as precision agriculture. Computer-based systems have been used in yield detection and crop quality and have been utilized in weeding and spraying techniques. Technology for smart irrigation has been developed that can detect water levels, nutrient content, temperature of soil, and even weather forecasting. [9]

These innovations have reduced the amount of manpower required on farms and the time required to be spent on certain tasks with far more efficient instruments. Thus far, a considerable improvement in overall crop yields and precision in management of farms have been noted which has made farmers and agriculturists optimistic about the involvement of new technologies in farming methods.[10]

Researchers at Pir Mehr Ali Shah Agriculture University and the University Institute of Information Technology in Rawalpindi Pakistan carried out in-depth research to highlight the benefits and

8 Scavo, A., Fontanazza, S., Restuccia, A. *et al.* "The Role of Cover Crops in Improving Soil Fertility and Plant Nutritional Status in Temperate Climates. A Review," *Agronomy for Sustainable Development,* September5**,** 2022,https://doi.org/10.1007/s13593-022-00825-0

9 Tanha Talaviya, Dhara Shah, Nivedita Patel, Hiteshri Yagnik, Manan Shah, "Implementation of Artificial Intelligence in Agriculture for Optimisation of Irrigation and Application of Pesticides and Herbicides, Artificial Intelligence in Agriculture," *ScienceDirect*,2020, https://www.sciencedirect.com/science/article/pii/S258972172030012X

10 "Hyperspectral Remote Sensing, Theory and Applications," *Elsevier,* August 7, 2020, https://www.sciencedirect.com/science/article/abs/pii/B9780081028940000097

possible applications of AI and information technology in Pakistan's agriculture sector.[11] The adopted AI models in the study not only detect diseases and viruses but also predict diseases in crops such as sugarcane and maize. These mechanisms can be incredibly useful to address challenges faced by farmers in Sindh and Balochistan province. However, farmers will require convincing to shift from their conventional methods.

Biotechnology

The use of biotechnology in agricultural practices has been seen as a very good way to efficiently address climate change and food security in Pakistan. Crops that are improved with biotech can reduce the number of inputs required and thus reduce the cost of production. Meanwhile, it also offers better yield which can support Pakistan's economy better in the long run. However, the legal process for authorization to use this technology by government and private companies stands in the way of allowing this sector to reach its full potential. Agricultural biotechnology laws are in place, but the implementation rules and guidelines remain to be established. [12] Farmers are often hesitant to make heavy initial investments due to the risk and uncertainty that exists among them. To counter such sentiments, governments need to provide awareness and support.

Economic Viability

An important aspect of transitioning to sustainable agriculture is the financial aspect of it. Farmers need to be encouraged to pursue environmentally friendly practices while also being able to keep their profits. To facilitate methods that conserve resources, reduce waste, and protect the natural environment, governments around the world have provided some initiatives in the form of financial assistance, grants, subsidies, and tax incentives to adopt more sustainable methods of farming and make use of the new developing technology, as mentioned above.

The European Union's Common Agricultural Policy is assisting farmers across Europe to enhance long-term food security and maintain agricultural diversity while keeping the economic sustainability of agriculture in mind. Initiatives under this program vary from increasing market transparency and cooperation between farmers, as well as fighting against unfair trading practices. Furthermore, new

11 Faiza Khan, Noureen Zafar, Muhammad Naveed Tahir, Muhammad Aqib, Hamna Waheed, Zainab Haroon, "A Mobile-Based System For Maize Plant Leaf Disease Detection and Classification Using Deep Learning. Frontiers in Plant Science," *Frontiers in Plant Science,*May 15, 2023, https://www.researchgate.net/publication/370799867_A_mobile-based_system_for_maize_plant_leaf_disease_detection_and_classification_using_deep_learning

12 "Agricultural Biotechnology Annual, Pakistan," *United States Department of Agriculture,* February 18, 2021, https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Agricultural%20Biotechnology%20Annual_Islamabad_Pakistan_10-20-2020

soil management techniques have been introduced that would assist in reducing greenhouse gas emissions on farms. Special attention is being paid to preventing biodiversity loss and preserving ecosystems, habitats, and landscapes. [13]

What Can Pakistan Learn?

Climate variability and change, pest infestation, and commodity price fluctuations are some of the challenges to crop productivity in Pakistan at the moment. Weather changes like long periods of drought and catastrophic floods that submerge agricultural land for long periods are steadily increasing. Just in 2022, 2.5 million hectares of land in Sindh was inundated.[14] The floods had hit before the harvesting season therefore the financial loss in terms of agricultural infrastructure and equipment was too much for the government to cover entirely.

Agriculture remains the main source of employment in Pakistan, but the vast majority of workers are a part of the rural population with limited access to education. This can be a big barrier to implementing sustainable technological methods that require workers to be well-equipped with the right information and specific skills to operate complex systems.

Even though Pakistan has an abundant source of fresh water from its glaciers, it still faces water scarcity issues because of a lack of development in irrigation systems. Therefore, efficient water management practices like drip irrigation, rainwater harvesting, and the use of drought-tolerant crops are critical for the future of agriculture in the country. Sustainable soil management techniques such as reduced tillage, cover cropping, and organic matter addition can help improve soil health, particularly in areas with soil degradation problems. Encouraging crop diversity and crop rotation can help prevent soil depletion, reduce pest pressure, and enhance resilience to climate change. Almost 62 million hectares of land in Pakistan are vulnerable to desertification and degradation. [15]

Organic farming practices, which minimize the use of synthetic chemicals and promote natural pest control, can be adopted to reduce chemical pollution and enhance soil and ecosystem health. However, to encourage the production and marketing of organically grown agricultural products,

13 "Key Policy Objectives of the CAP 2023-27," *European Commission,* https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-2023-27/key-policy-objectives-cap-2023-27_en

14 "The 2022 Pakistan Floods: Assessment of Crop Losses In Sindh Province Using Satellite Data," *International Centre for Integrated Mountain Development, Pakistan Agricultural Research Council,* 2022, https://lib.icimod.org/record/35984

15 "Pakistan's 62m Hectares Vulnerable to Desertification: Experts," *Business Recorder,* August 28, 2022, https://www.brecorder.com/news/40194248

consumers need to be conveyed the health advantages of these products to provide economic incentives for farmers to adopt such practices. Additionally, availability and access to knowledge and training on sustainable practices for farmers are crucial for a successful transition.

Spain is a part of the European Union which allows their farmers to benefit from targeted subsidies. Under the Common Agriculture Policy, farmers have been encouraged to increase conservation efforts of soil and water. As a result, nearly 30% of olive groves in Spain use cover crops at present.[16] Furthermore, a coordination body under the Agricultural Knowledge and Innovation System in Spain has been set up to assist farmers in rural areas in acquiring digital skills. [17] Similar steps can be taken in Pakistan to assist the vast rural population employed in the agriculture sector to benefit from the developing technologies that can make their jobs more efficient and easier.

Collaborative Efforts

International organisations and partners can play a significant role in promoting sustainable agriculture in Pakistan through collaborative efforts with government bodies.

US Pakistan Green Alliance is a great example of a partnership between two countries in addressing the impacts of climate change. This alliance is promoting renewable energy and sustainable agriculture through investment in infrastructure such as the solarisation initiative which will give 10,000MW of solar power. Additionally, a grant has been given to the Lahore University of Management Sciences (LUMS) to boost their research and development of electric vehicles. Moreover, a $500,000 project is underway in Sindh to recover lost electricity output that occurred due to the 2022 floods. [18]

The Government of Balochistan has collaborated with the FAO on the Gwadar-Lasbela Livelihood Support Project. The initiative is being financed by the International Fund for Agricultural Development and will aim to equip farmers with skills and knowledge to move towards an environmentally sustainable future, while also achieving food security. Furthermore, the project will

16 "In Climate Fight, Europe's Farmers Turn To Tech and Tradition," *Japan Times,* September 15, 2023, https://www.japantimes.co.jp/environment/2023/09/15/sustainability/europe-farming-tech-climate/

17 "At a Glance: Spain's CAP Strategic Plan," *European Commission,* August 31, 2022, https://agriculture.ec.europa.eu/system/files/2023-04/csp-a-a-glance-spain_en.pdf

18 "US-Pakistan Green Alliance Framework," *Tribune,* March 27, 2023, https://tribune.com.pk/story/2408376/us-pakistan-green-alliance-framework

also benefit fisheries in Gwadar and Lasbela which could uplift the lives of 100,000 rural households.[19]

Conclusion

Sustainable agriculture is imperative for mitigating climate change. By embracing practices like agro-forestry, reduced tillage, and cover cropping, sustainable agriculture not only traps carbon but also enhances soil fertility and resilience to extreme weather events, which are becoming more frequent due to climate change. Sustainable practices can be used to ensure that agriculture can meet the demands of the world's growing population without depleting natural resources. They preserve soil health, maintain biodiversity, and protect water sources, all critical for long-term food production. Sustainable farming methods also enhance the nutritional quality of crops, ensuring that the food produced is abundant and nutritious.

Moving towards sustainable methods in agriculture can assist Pakistan in addressing two of its central concerns: food security and climate change. Certain technologies have already been researched and tested, but help is needed to spread use and application. Better efforts must be made in coordination and collaboration between government and private organizations, or individually run groups, on ideas and practices. Furthermore, smaller NGOs can assist in vocational training in parts of the country that are yet to be within reach of large-scale projects.

Sustainable agriculture can bolster Pakistan's rural communities' economic stability by enhancing smallholder farmers' productivity, promoting agribusinesses, and creating diversified income sources. By adopting climate-smart practices, such as drought-resistant crop varieties and sustainable irrigation methods, Pakistan can better cope with the challenges posed by a changing climate.

It represents a holistic approach to agriculture that balances the needs of today's population with the imperative of preserving natural resources for future generations.

19 "Government and FAO Collaborate to Enhance Balochistan's Agriculture and Fisheries," *Food and Agriculture Organization of the United Nations,* July 14, 2023, https://www.fao.org/pakistan/news/detail-events/en/c/1644749/