

# MODERNISING THE AGRICULTURE SECTOR IN PAKISTAN



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## Abstract

The modernisation of the agriculture sector is rapidly emerging as a critical imperative in Pakistan. This article touches on the intertwined issues of climate change, food security and economic health in the context of the agriculture sector in Pakistan and highlights the multifaceted process of modernising agricultural activities, including sustainable practices, technological advancements, corporate farming and artificial intelligence. In order to ensure the wellbeing of Pakistan's economy and its population, it is vital that steps are taken to promptly modernise the current practices of the agriculture sector and promote efficient, climate-smart techniques.

## Keywords

Agriculture, Corporate Farming, Food Security, Artificial Intelligence, Climate Change.

## Introduction

Pakistan's economy and the livelihoods of the country's population are heavily reliant on agriculture; the agriculture sector not only contributes significantly to the nation's GDP but also provides food, employment and income to millions of people in Pakistan. Despite the immense importance of agriculture in Pakistan, the combination of climate change and outdated agricultural practices have hindered this sector and prevented the optimal use of the country's land and natural resources. Consequently, there is a pressing need to modernise agricultural practices in Pakistan with a focus on addressing food insecurity, reducing and combatting the effects of climate change and maximising the economic potential of the country's land.

## Cropping Seasons and Major Crops

Pakistan's cropping seasons are divided into two broad categories, the first of which is "Kharif", that begins in April and continues till June and involves harvesting between October and December. The crop cycle of this season comprises of sugarcane, rice, maize, cotton, mash, moong, jowar and bajra.

The second crop season, "Rabi", involves sowing of crops between October and December and harvesting between April and May. Crops of this season include wheat, gram, masoor lentils, rapeseed, barley, tobacco and mustard.

The crops that contribute the most to the agriculture sector in Pakistan include cotton, sugarcane, rice, maize and wheat.<sup>1</sup>

**Table-1: Agricultural and Irrigated Areas by Provinces of Pakistan (Million ha)**

Location	Total Area	Agricultural Land	Cultivated Area	Rain Fed Area
Pakistan	57.06	33.63	21.20	4.95
Punjab	17.48	14.51	12.42	1.60
Sindh	14.09	7.35	4.88	1.43
Khyber Pakhtunkhwa (KP)	8.34	7.32	1.91	1.07
Balochistan	17.15	4.45	1.99	0.85

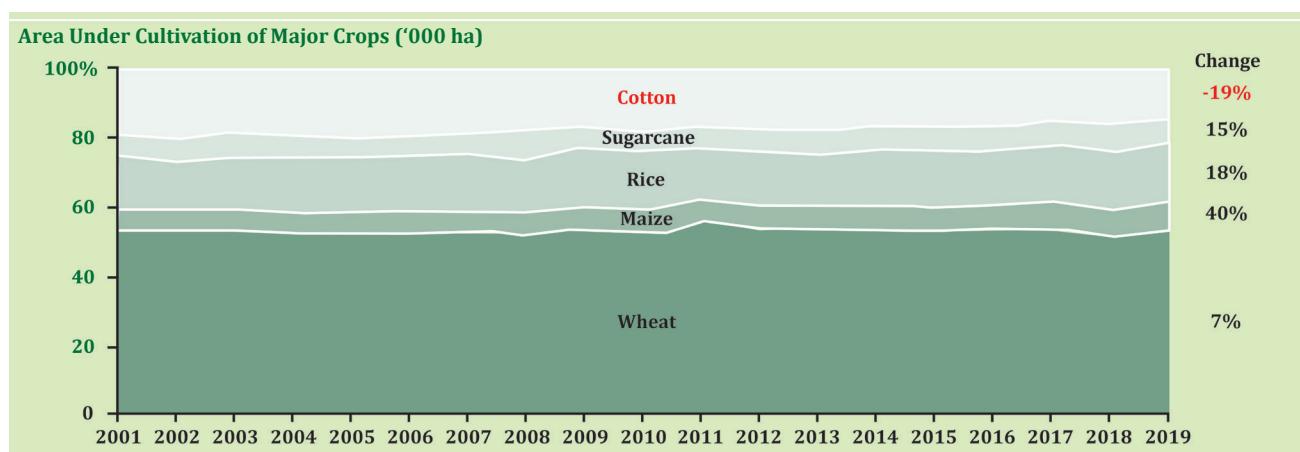
**Source: Qureshi, Asad Sarwar (2015)**

## Corporate Farming

The concept of corporate farming has been gaining traction in Pakistan over recent years. Corporate farming refers to agricultural practices being carried out and managed on a large scale by corporations.<sup>2</sup>

- Benefits of corporate farming include:-
  - Increased efficiency in production and yield.<sup>3</sup>
  - Production of higher quality output.
  - Improved food security.
  - Increase in employment opportunities.
  - Sustainable agriculture with lower environmental risk.
  - Gaining access to global agriculture markets through exports.

**Figure-1: Area Allocated to Major Crops in Pakistan (2001-19)**



**Source: Pakistan Bureau of Statistics**

- Potential disadvantages of corporate farming include:
  - Excess mechanisation and use of pesticides, leading to pollution.
  - Displacement of small-scale farmers.<sup>4</sup>
  - Prioritisation of profit over food security.

## **Special Investment Facilitation Council (SIFC) and Green Pakistan Initiative**

SIFC is a civil-military hybrid council that has been established to act as a “single window” forum to facilitate foreign investment and economic growth in Pakistan.<sup>5</sup> The Economic Development Board in Singapore and the Council for the Promotion of International Trade in China are bodies similar to SIFC, formed with the intention of promoting economic growth and facilitating international dealings respectively.

A corporate farming initiative titled the “Green Pakistan Initiative” has recently been launched under the ambit of the SIFC with the aim of utilising the country’s barren, uncultivated land and attracting foreign investment.<sup>6</sup> The SIFC’s main role in this initiative is to encourage and facilitate the investment of foreign governments or corporations in the project.

## **Land Information Management System-Centre of Excellence (LIMS CoE)**

Prime Minister Shehbaz Sharif, inaugurated the LIMS CoE in July, 2023.<sup>7</sup> It was set up with the aim of providing information regarding crops, land, water resources, weather conditions and pest-control in real time. This system, if developed and utilised to its full potential, may be a major contributor to the modernisation of agriculture in Pakistan.

## **Relevant Legal Framework**

- **Domestic Law**

The preamble of the Pakistan Environmental Protection Act (PEPA), 1997 highlights the importance of sustainable development and the need to balance economic growth with environmental protection.<sup>8</sup>

- **International Law**

- The Paris Agreement is an international

treaty that deals with climate change and is legally binding on its parties. The Paris Agreement was adopted by 196 Parties, including Pakistan, at the UN Climate Change Conference (COP21) in Paris, France, on December 12, 2015.<sup>9</sup>

- Article-2.1(b) of the Paris Agreement highlights the need for increasing the ability to adapt to the adverse impacts of climate change, foster climate resilience and lower greenhouse gas emissions in a manner that does not threaten food production. These intertwined problems regarding climate, agriculture and food security are of particular significance in South Asian countries, including Pakistan.

## **Forestry and Agriculture**

Pakistan is deficient in forests, which has a direct impact on the agriculture sector. Although forestry itself comprises a very small percentage of the agriculture sector in Pakistan, forests have a significant role in promoting crop production by regulating the climate and water resources. The fast-growing population in Pakistan, paired with a lack of awareness, has led to unsustainable logging and overharvesting of wood for fuel and charcoal.<sup>10</sup> Other factors contributing to the decreasing forest cover include pests, diseases and forest fires. Therefore, in order to promote the agriculture sector, it is necessary to promote sustainable forestry and address the overharvesting of Pakistan’s forests.

## **Climate Change and Agriculture**

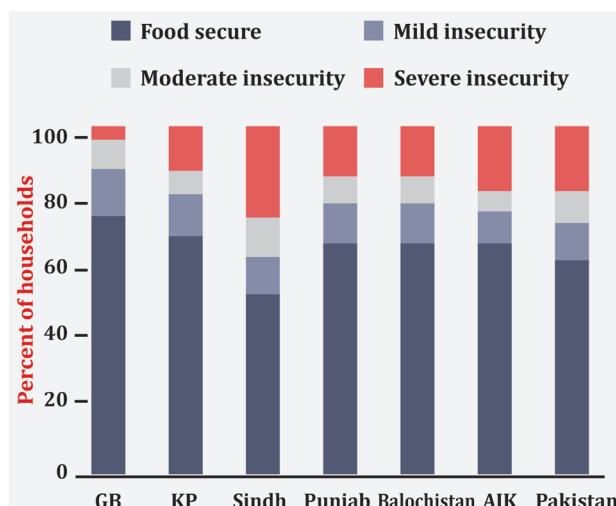
Climate change is an issue that is closely interlinked with the productivity of the agriculture sector and research has shown that Pakistan is the fifth most vulnerable country in the world to climate change.<sup>11</sup> As a result, the country is plagued with disasters such as floods, including flash floods, riverine floods and coastal floods, as well as drought and tropical cyclones. According to a study, the effects of climate change in Pakistan may lead to a reduction of between 8-10% in agricultural productivity by the year 2040, with a large toll being taken on the production of wheat crops in particular.<sup>12</sup> For this reason, steps need to be taken to integrate climate-friendly practices into the agriculture sector of Pakistan.



## Food Insecurity

Although Pakistan is an agriculturally dominant nation, food insecurity continues to be one of the most pressing issues in the country. According to a survey conducted by the Pakistan Social and Living Standards Measurement, 16.4 households out of 100 reported moderate to severe food insecurity in the fiscal year 2019-2020.<sup>13</sup>

**Figure-2: Household Food Insecurity in Pakistan by Province/ Region**



**Source:** National Nutritional Survey 2018  
(Ministry of Health and UNESCO)

Additionally, according to the 2018 National Nutritional Survey of Pakistan, four out of ten children under the age of five have stunted growth, which is likely the result of improper nutrition. Thus, it is imperative to develop the country's agricultural practices with a focus on improving food security.

## Agricultural Emissions

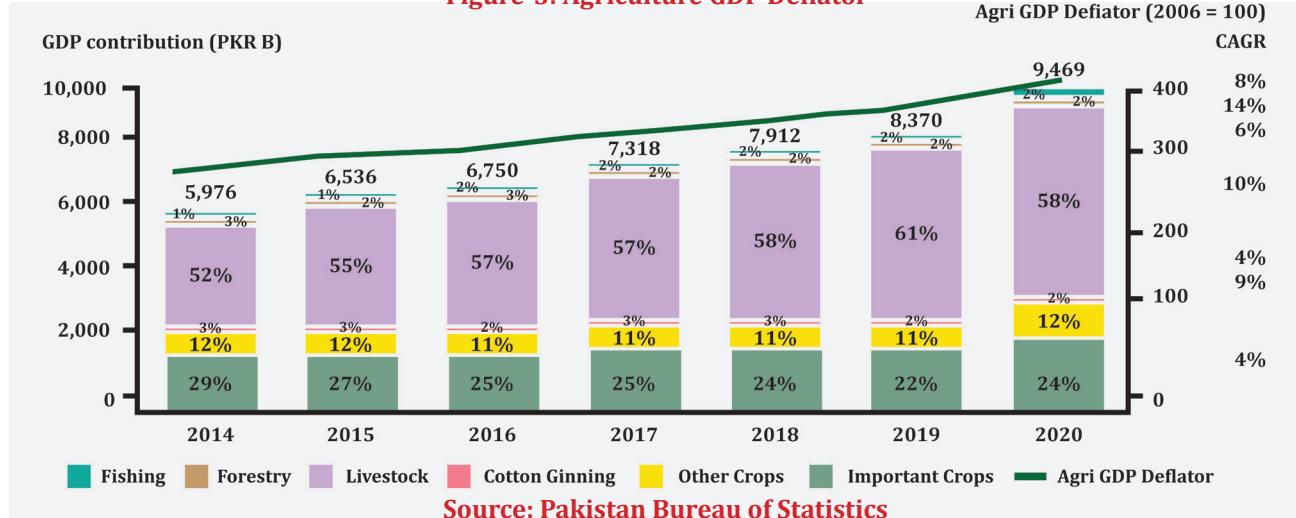
Globally, the agricultural sector is a major contributor to greenhouse gas emissions, accounting for around 11% of global CO<sub>2</sub> emission.<sup>14</sup> Additionally, agriculture's link with deforestation causes the sector to contribute significantly to indirect emissions.

However, in countries such as Pakistan, India, Afghanistan, Bangladesh, Nepal, Bhutan, Myanmar and Sri Lanka, agriculture accounts for between 23-67% of the region's total greenhouse gas emissions, which is significantly higher than the global average.<sup>15</sup> In addition to this, greenhouse gas emissions in Pakistan from the agriculture, forestry and other land use sector consistently increased between the years 1994 and 2017.<sup>16</sup>

## Socio-Economic Role of Agriculture

If steps are not taken to adapt the current agriculture practices in Pakistan, it is likely there will be significant consequences of climate change-induced loss of crop production on the country's economy by the year 2050. Since agriculture is one of the dominant sectors of the economy, a reduction in crop production would lead to a drastic decline in GDP. Additionally, a reduction in crop production due to climate change would not only affect the agricultural sector, but would have effects extending to all industries linked with agriculture, such as manufacturing. Consequently, there would be a steep rise in the prices of food and commodities, putting the livelihoods of millions of people at risk.<sup>17</sup> Thus, it is essential for Pakistan to integrate "Climate Smart Agriculture" practices into the agriculture sector.

**Figure-3: Agriculture GDP Deflator**



## Climate Smart Agriculture (CSA)

CSA is an emerging concept in the present discourse related to climate change mitigation and adaptation. It can be defined as agricultural practices that mitigate greenhouse gas emissions, sustainably improve productivity and income and allow for adaption to climate change.<sup>18</sup> Despite the potential of CSA practices to enhance agricultural sustainability, adoption rates of CSA practices in Pakistan are reported to be very low.<sup>19</sup> One of the most well-known methods of CSA that may be of relevance to Pakistan is greenhouse horticulture.

## Greenhouse Horticulture

Agricultural production techniques that take place in a controlled environment, such as greenhouse horticulture, may be a suitable method of ensuring environmentally sustainable agriculture while simultaneously increasing productivity.

### • Advantages

- Extension of growing seasons, allowing seasonal crops to be grown round the year.
- The ability to grow a wider variety of crops.
- Reduction in the effects of pests, weeds, disease and harsh climate compared to standard methods of crop cultivation.
- Improvement in the management of resources such as water and energy.
- Reduction in production of greenhouse gases.

- Higher yield produced on smaller areas of land as compared to open field farming.<sup>20</sup>

### • Disadvantages

- High initial costs.
- Weather dependency.

There is a broad range of types of greenhouses, including greenhouses made of glass, net or screen, low-tech greenhouses that do not contain temperature control systems and high-tech greenhouses with fully automatised climate control.<sup>21</sup>

While greenhouse farming is not a new practice, the development in the IT sector and the introduction of new technologies has led to "smart" methods of conducting this type of farming. For example, applications have been developed that are able to monitor and control the humidity and temperature within the greenhouses.<sup>22</sup> Additionally, it is anticipated that greenhouse automation will evolve into systems that are even more intelligent in the future.

## Autonomous Greenhouses

It is also expected that autonomous greenhouses will become the norm in the near future, particularly in the most technologically advanced countries. Most of the manual work in an autonomous greenhouse would be replaced by machines and the above-ground and under-ground climate would be kept under control with the use of sensors, eliminating or reducing the need for day-to-day interference by the growers.<sup>23</sup>



The entire greenhouse would be fully controlled and monitored even if the physical location of the grower controlling the greenhouse is at a distance. Despite the many challenges in replacing human labour with machines, new technology is gradually being integrated in greenhouse horticulture. The use of robots, machine learning and artificial intelligence is likely to change the way greenhouse farming is conducted across the globe.

### **Costs of Heating and Cooling Greenhouses**

One of the main issues associated with greenhouse farming is the high cost of its implementation. However, it has been found that the cost of heating and cooling in greenhouses makes up about 70–85% of the total cost of operations, excluding the cost of labour.<sup>24</sup> Therefore, reducing the costs linked to temperature maintenance could result in a far more economic and sustainable method of greenhouse horticulture. To reduce these costs, greenhouses must be energy efficient and able to use renewable energy resources such as solar energy, or biomass and geothermal heat.<sup>25</sup>

### **Solar Greenhouses**

Utilising solar energy is one of the most feasible methods to reduce the costs of greenhouse farming. Greenhouses can use solar energy either through active or passive systems.<sup>26</sup> An active solar greenhouse system uses solar panels to generate electricity from sunlight and then uses this energy to maintain the

temperature in the greenhouse. In contrast, a passive solar greenhouse involves structures that make use of heat and light from the sun without the need for mechanical devices.

A passive solar greenhouse would only be able to keep the greenhouse heated and would not be able to reduce the temperature during hot weather, making it unsuitable for summers in Pakistan. As an active solar greenhouse could be used both for heating and cooling, it would be the preferable choice out of the two.

### **Biomass and Geothermal Heat Greenhouses**

Biomass and geothermal heat are also widely used for temperature maintenance in greenhouses. Biomass heating in greenhouses involves the use of renewable organic matter as heating fuel for boilers or furnaces, whereas geothermal heating involves the installation of a tube under the greenhouse floor which allows renewable ground heat to spread throughout the greenhouse. These methods of temperature control are only effective for colder regions, where it is necessary to keep the greenhouse warm and therefore would not be preferable for use in Pakistan, where the bulk of agricultural activity takes place in Punjab.

### **Other Relevant Technology**

Aside from the incorporation of climate-smart greenhouses in the agriculture sector, other methods

**Figure-4: Passive Solar Greenhouse vs Active Solar Greenhouse**

Passive Solar Greenhouse	
Pros	Cons
Sustainable energy source	Ineffective on cloudy/rainy days
Keeps greenhouse warm during colder months	May overheat during warm months
Saves cost of power generation	Limited automation
Comparatively inexpensive	Unsuitable for large-scale agriculture

Active Solar Greenhouse	
Pros	Cons
Sustainable energy source	Ineffective on cloudy/rainy days
Maintains greenhouse temperature during warm and cold seasons	May require regular maintenance
Saves cost of power generation	Expensive to install
Suitable for large-scale agriculture	

**Source: Compiled by Author**

and technologies that Pakistan may consider investing in or conducting research on include:-

- Drone or satellite imagery to monitor crop growth and density.
- Automated seeders or drones to plant seeds rapidly and efficiently in hard-to-reach areas.
- Automated sprayers or drones to apply pesticides or other treatments to crops.<sup>27</sup>
- Autonomous pollinator drones that are able to pollinate plants without damaging them.
- Micro-irrigation, i.e. a slow and low-pressure mode of irrigation that prevents overwatering.
- Artificial intelligence.

### **Role of Artificial Intelligence (AI) in Agriculture**

With the steady increase in the use and understanding of AI across the globe, the following uses of AI in the agriculture sector may be of relevance to Pakistan:-

- Accurate crop-yield predictions and yield-mapping for efficient crop planning.
- Predictions of pest infestations before occurrence.

- Defining of the optimal mixture of pesticides to reduce risk to crops.
- AI-run robots for remote agricultural operations.
- Price forecasting for crops to help firms or farmers get the best price for their harvest.
- Identifying irrigation leaks and ensuring optimal distribution of water to crops.<sup>28</sup>

### **Way Forward/ Recommendations**

- Government of Pakistan should collaborate with international organisations to learn best practices regarding climate smart agriculture.
- The Government of Pakistan should facilitate foreign investment in technology for active solar greenhouses in Pakistan.
- Incentives should be offered to farmers and corporations for investment in solar-powered greenhouses.
- The Government of Pakistan should facilitate research and development to improve the efficiency of greenhouse horticulture in Pakistan, with a focus on emerging technology and AI use.



- Initiatives should be introduced for the education of farmers and corporations regarding climate smart practices.

## Conclusion

As Pakistan is facing the constant threat of natural disasters due to climate change, it is necessary for Climate Smart Agriculture practices to be integrated in

the agriculture industry. Pakistan is legally obligated by both domestic and international law to balance the protection of the environment with economic growth and food security. The implementation of greenhouse horticulture is likely to aid the country in achieving these aims, thereby benefitting the country's population and the nation as a whole.

## AUTHOR

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