

# Food security, agriculture, climate change, policy implementation, soil fertility

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## Citation:

Parveen, F., Ahmad, T., Ahmad, M., Khan, N. W., & Orakzai, J. K., & Islam, M. u. (2023). Food security, agriculture, climate change, policy implementation, soil fertility. *Khyber Journal of Public Policy*, 2(4), Winter, 241-271

## Article Info:


Received: 15/11/2023  
Revised: 22/11/2023  
Accepted: 10/12/2023  
Published: 31/12/2023

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## Abstract:

Food security remains a critical challenge for Pakistan, exacerbated by factors such as rapid population growth, urbanization, climate change, and economic instability. The National Food Security Policy, introduced in 2018, provides a comprehensive framework to address food availability, accessibility, utilization, and stability. However, ineffective implementation has hindered its success. This paper evaluates Pakistan's food security status, analyzes challenges in agriculture, and examines government policies aimed at overcoming these issues. It explores key factors such as low agricultural investment, poor crop yields, water scarcity, and climate change, which contribute to food insecurity. The study proposes a strategic plan to improve food security, including time-bound KPIs, contingency measures, and actions to protect agricultural land from real estate development. Additionally, it recommends mandatory soil fertility testing to enhance agricultural productivity. Addressing these challenges will be essential for ensuring long-term food security and economic stability.

## Key words:

Food security, agriculture, climate change, policy implementation, soil fertility

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## *Introduction*

Food security is of paramount importance for the government of Pakistan. Several steps have been taken to ensure food availability, accessibility, and sustainability. In this regard, Pakistan introduced its first National Food Security Policy in 2018. The policy was comprehensive and aimed to address food insecurity and climate change issues at the national level. However, food security remains a key challenge due to high population growth, rapid urbanization, low purchasing power, high price fluctuations, erratic food production, and inefficient food distribution systems. Similarly, this challenge has been exacerbated by the lack of implementation of the policy in letter and spirit.

The World Food Summit (1996) defined food security as “Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for a healthy and active life” (Summit, 1996).

There are four further dimensions of food security as per Pakistan's National Food Security Policy of 2018:

- Availability of food, which includes food production, stock levels, net trade, and distribution. It also addresses the supply side of food security.
- Accessibility, which means that all the population has sufficient purchasing power to meet their food needs. Insufficient food access has led to a greater policy focus on incomes, expenditures, markets, and prices to achieve food security objectives.
- Utilization, which refers to the way the body makes the most of various nutrients in food. It includes feeding practices, food preparation, diet diversity, and intra-household distribution of food. Collectively, it determines the nutritional status of individuals.
- Stability of the other three dimensions over time. Even if your food intake is adequate today, you are still considered food insecure if you have inadequate access to food periodically, risking a deterioration of your nutritional status. Adverse weather conditions, political instability, or economic factors (such as unemployment and rising food prices) may impact your food security status.

This paper explores Pakistan's current position regarding food security, the country's commitments under the Sustainable Development Goals to reduce hunger, and the issues and challenges confronting Pakistan's agriculture sector. It also examines government policies to address these problems and the role of federal and provincial governments in the agriculture sector. The study has also framed a plan of action with time-bound KPIs to address the challenges in Pakistan's agriculture sector and has attempted to foresee

situations that may potentially destabilize or thwart the success of these action plans, along with a contingency plan.

### ***Problem Statement***

Feeding Pakistan's growing population through a sustainable food basket is essential. Agriculture remains the largest contributor to Pakistan's GDP. However, the lack of implementation of the food security policy has led to a food crisis in Pakistan. Therefore, there is a dire need to evaluate and examine existing hurdles and to formulate a meticulously planned policy that ensures pragmatic and workable solutions.

### ***Scope***

This study will examine the nutritional conditions of the people of Pakistan, especially children, covering access to nutritious and sufficient food, agriculture and livestock production, as Pakistan relies heavily on agriculture for food production. It will address efficient land use to maximize food production, preserve agricultural land, urban development, determinants of food self-sufficiency, and reducing food shortages. Moreover, this study will analyze the above factors and examine the gaps between existing policies and the current situation. Further, it will assess the role of stakeholders, including the Ministry of Food Security and Research, in relation to the role of the erstwhile Ministry of Agriculture and Livestock. The study will evaluate Pakistan's compliance with its commitments under the Sustainable Development Goals and will compare and contrast two developed and developing countries. This study will highlight the issues and challenges Pakistan faces in achieving food security and will suggest workable solutions to make Pakistan a food-secure country.

### ***Research methodology***

The research will be based on both qualitative and quantitative methods as the research group has relied on secondary data for exploring the subject and making analysis of the subject of investigation. The research group has studied secondary data such as public sector policies, journals, media reports and studies.

### ***Literature Review***

Abid Hussain and Jayant Kumar Routray's article, "Assessing Food Security in Pakistan: Status and Influencing Factors" (Hussain, 2012), aims to gauge the level of self-sufficiency in food, identify the shortfall in food availability, and understand the disparity between the national food security benchmark and the actual consumption by citizens. Additionally, their research seeks to

scrutinize the primary economic and environmental factors contributing to food insecurity in the nation.

In his paper titled "Climate Change, Irrigation Water Crisis, and Food Security in Pakistan," Muhammad Asif investigates the consequences of climate change on food security in Pakistan, a nation heavily reliant on agriculture. His study underscores the increasing temperatures, shifting precipitation patterns, glacier melting, evaporation, and heightened demand for irrigation water. The report also delves into Pakistan's irrigation system, water scarcity, and the elevated inflation rate. Water shortages have prompted farmers to transition from water-intensive crops to those requiring less water, thereby exerting pressure on the food market. Furthermore, the changing temperature and rainfall patterns result in uneven surface water availability, leading to sudden floods and damage to both food resources and infrastructure (Asif, 2013).

Tauseef Javad and Sajad Ahmad advocate for the transformation of agricultural practices and the adoption of climate-resilient techniques to tackle food security and climate change concerns. They posit that vulnerable farmers can play a pivotal role in finding solutions, with adaptive farming practices bolstering the resilience of rural communities and potentially mitigating the impacts of climate change. A collaborative working group is poised to propose a strategy for sustaining food security in Pakistan (Ahmad, 2022).

As outlined by Bing in 2019, research and development (R&D) play a substantial role in enhancing agricultural productivity and enabling the world to produce more food within limited land resources. Their projections indicate a substantial food deficit of approximately 70% between the anticipated calorie requirements in 2050 and the crop-based calorie production from 2010, underscoring the necessity for increased investment in research and development to ensure sustainable agriculture (Gaffney).

Imran Khan, Hongduo Li, and their fellow researchers, in their paper, analyze the spatial disparities in potential and actual yields of major food crops in Pakistan. Their study identifies gaps in production at both provincial and national levels, with maize demonstrating the most significant potential shortfall at the national level. These production gaps vary based on climatic conditions, temperature variations, rainfall patterns, and topographical factors. The suggested solutions involve strengthening agricultural infrastructure and optimizing resource allocation to narrow these gaps and enhance national grain production, security, and food availability (Khan, 2020).

A study by Touqeer Ahmad and Abdul Saboor reveals the deteriorating state of food utilization and sustainability in Pakistan, highlighting that non-farmers experience a higher level of food insecurity (8%) compared to farmers (4%). The research advocates for a comprehensive approach to food security policies, with a particular emphasis on disseminating knowledge about dietary diversity, enhancing the quality of education, and improving healthcare facilities. The recommendations include adopting a holistic

strategy to enhance both the availability and accessibility of food resources (Ahmad, 2022).

## Legal frame work

The legal framework for food security in Pakistan encompasses a range of laws, regulations, and policies at the federal and provincial levels. Here are some key components of the legal framework for food security in Pakistan:

1. **National Food Security Policy 2018**

The National Food Security Policy 2018 is a comprehensive policy framework aimed at ensuring food security for all segments of the population. It provides a roadmap for achieving food security through various measures, including agricultural development, price stability, and safety nets.

2. **Agriculture Policy**

Pakistan has both federal and provincial agriculture policies that outline strategies and programs for the development of the agriculture sector. These policies address issues such as crop production, land use, water management, and technology adoption.

3. **Seed Law 1976**

This law governs the quality, sale, and distribution of seeds, ensuring that farmers have access to high-quality and certified seeds.

4. **Pesticide Ordinance 1971**

The Agriculture Pesticides Ordinance, 1971, was enacted to regulate the import, manufacture, formulation, sale, distribution, and use of pesticides.

5. **Livestock Laws**

Pakistan's Prevention of Cruelty to Animals Act (1890) aims to protect many animals, including draught animals. This law is, however, outdated and does not reflect the prevalent scientific, cultural, or commercial compulsions pertaining to animal welfare. The Halal Authority Act (2015) mandates the humane treatment of animals throughout the slaughter process.

6. **Food Safety Laws**

- The Pure Food Ordinance of 1960 consolidates and changes the law governing food preparation and sale.
- Cantonments Pure Food Act 1966
- Pakistan Hotels and Restaurants Act 1976
- PSQCA Act 1996

The Pakistan Food Authority (PFA) Acts and other related laws govern food safety and standards to protect consumers from adulterated and unsafe food products in provinces.

7. **Land Tenure Laws**  
Land tenure laws, including tenancy laws, regulate land ownership and leasing, which are essential for agricultural production. These laws have been promulgated at different times.
8. **Water Laws, Pakistan Water and Power Development Authority Act, 1958**  
Laws related to water management and irrigation are crucial for ensuring efficient and equitable access to water resources for agriculture.
9. **Environmental Laws**  
The Pakistan Environmental Protection Ordinance 1983 and the Pakistan Environmental Protection Act 1997 regulate environmental issues such as land use, water quality, and sustainable farming practices.
10. **Trade and Tariff Policies**  
International trade policies and tariffs can influence the availability and prices of food products in the domestic market.
11. **Social Safety Net Programs**  
Programs such as the Benazir Income Support Program (BISP) provide financial support to low-income households, contributing to food security.
12. **Provincial Regulations**  
In addition to federal laws, each province in Pakistan has its own regulations and policies related to agriculture, land, and food security.
13. **National Disaster Management Act 2010**  
Laws and policies related to disaster management and relief efforts are essential for responding to food-related emergencies, such as natural disasters.
14. **International Agreements**  
Pakistan is a signatory to international agreements and treaties related to food security, trade, and agricultural development, such as the World Trade Organization (WTO) agreements.

The legal framework for food security in Pakistan is a complex and evolving system that addresses various aspects of food production, distribution, and consumption. Ensuring that these laws and policies are effectively implemented is essential for achieving food security and improving the well-being of the population. It's important to note that the legal landscape in Pakistan may change over time, so it's advisable to consult the most current laws and regulations for a complete understanding of the legal framework for food security in the country.

## SITUATION ANALYSIS

The food shortage of the 1950s compelled the government to introduce reforms in the agriculture sector. As a result, several reforms were introduced during the Ayub era, including land reforms, the introduction of science and technology, the Indus Water Treaty, and the establishment of the Agricultural Development Bank to provide loans and incentives to farmers. Consequently, by the 1970s, these steps led to higher production, as small farmers also adopted modern techniques. Similarly, there were rising trends in agricultural production during the 1990s. However, the early 2000s were disastrous, and Pakistan faced a food crisis in 2007. In response, by the end of the 2000s, major steps were taken, such as generous support programs, biotechnology, tunnel farming, and the vertical expansion of crops. Currently, we have achieved a 3-4 times increase in output for almost all major crops, which can be considered a significant increase compared to the 1950s. (Raja, 2023)

When considering Pakistan, it becomes evident that food security is a pressing concern encompassing a wide range of aspects, such as the nutritional well-being of children, the production of agricultural and livestock resources, land use, and the equilibrium between urban expansion and agricultural activities.

### *Nutrition Conditions in Pakistan*

Imbalance of nutrients in the human body is termed malnutrition. The World Health Organization defines malnutrition as "deficiencies or excesses in nutrient intake, imbalance of essential nutrients, or impaired nutrient utilization" (Nazir, 2023).

Malnutrition poses a significant threat to the development, health, and future of the people of Pakistan. It hinders the nation's prosperity and growth. Millions of individuals, especially women and children, suffer from malnutrition. Statistics reveal that almost half of the children under the age of five face stunted growth, and 30% experience wasting. Malnutrition adversely affects overall productivity, increases healthcare expenses, and significantly reduces economic growth (Effendi, 2023).

Pakistan ranks third globally in the proportion of children experiencing stunted growth, following Nigeria and India. It was projected that 45% of

children suffer from stunting, 10.5% experience wasting, and 31.6% are underweight in Pakistan. This concurrent condition is most prevalent in rural areas (6.8%), among children whose mothers lack formal education (7.7%), and in households within the lowest wealth quintiles (10.7%). Geographically, Sindh province has the highest incidence of concurrent stunting and wasting (10.0%), followed by Balochistan (6.5%), Punjab (4.3%), and Khyber Pakhtunkhwa (3.7%) (Nazir, 2023).

Despite being recognized as a persistent crisis for many decades, malnutrition remains a silent but grave threat to Pakistan's health, development, and future. While there have been signs of progress in various healthcare sectors, malnutrition continues to be alarmingly prevalent, impeding the nation's advancement and prosperity.

It is argued that a strategy combining poverty alleviation with policies to ensure food security offers the best hope for swiftly reducing mass poverty and hunger. However, recent studies show that economic growth alone will not solve the problem of food security. What is needed is a combination of:

- income growth;
- direct nutrition interventions; and
- investment in health, water, and education.

Food insecurity, hunger, and malnutrition lead to poor physical and cognitive development, low productivity, and persistent poverty.

Dietary diversity is intricately associated with the economic aspect of food security, serving as an indicator of the nutritional value within one's diet. According to the "World Food Program" report on Pakistan, 18% of the population experiences undernourishment, which is categorized as "serious" according to the Global Hunger Map criteria (Hashmi, 2021).

Furthermore, findings from the National Nutritional Survey underscore the chronic nature of malnutrition in Pakistan. The chart below illustrates the prevalence of malnutrition among children under the age of five years in Pakistan:

<b>Category</b>	<b>Urban</b>	<b>Rural</b>
Stunting	34.8%	43.2%
Wasting	16.2%	18.6%
Underweight	24%	31.6%
Overweight	9.6%	9.4%



### *Agriculture production*

Pakistan's national emblem features cotton, wheat, tea, and jute, which were the major crops at the time of Pakistan's independence, reflecting the agricultural base of the economy. Being an agrarian country, Pakistan's survival and growth are directly dependent on agriculture due to its socio-political and economic impacts.

Pakistan has a total land area of around 80 million hectares, with approximately 58 million hectares surveyed by the Geological Survey of Pakistan. According to their findings, about 22 million hectares (38%) are used for cultivation, with nearly 19 million hectares being irrigated, while the remainder relies on rain-fed methods (Barani). Approximately 4 million hectares (7%) are covered by forests, and the remaining 8 million hectares of the surveyed land can be categorized as cultivable waste.

The agriculture sector in Pakistan is divided into four main subsectors: livestock, crops, forests, and fisheries. Livestock makes the largest contribution, accounting for 56% of the total agricultural production, while the crop sector contributes 38%, with major crops making up 25% and minor crops contributing 13%. Fisheries and forestry each contribute 2% to the overall agricultural production (Raja, 2023).

According to the Food and Agriculture Organization (FAO) of the United Nations, Pakistan holds prominent global rankings in various agricultural and food production categories:

- **2nd place** in the production of indigenous buffalo meat, buffalo milk, and oilseed.
- **3rd place** in the production of chilies and cottonseed.
- **4th place** in the production of mangoes, pulses, goat milk, cotton lint, goat meat, roots, and tubers.
- **5th place** in the production of chickpeas and spices.
- **6th place** in the production of wheat, sugarcane, apricots, spinach, okra, and dates.
- **7th place** in the production of cauliflower and broccoli.
- **8th place** in the production of tangerines, mandarins, fresh tropical fruits, tobacco, and onions.
- **11th place** in the production of pistachios, oranges, and wool.
- **13th place** in rice production.
- **14th place** in the production of bird eggs and peas.

The agricultural sector plays a vital role in Pakistan's economy, accounting for 22.9% of the GDP and generating employment for 37.4% of the population. It not only ensures food security but also supplies raw materials to the industrial sector. Additionally, it serves as a source of foreign exchange earnings and is crucial for sustainable economic growth. However, in recent years, Pakistan has faced climatic shocks that have adversely affected the agriculture sector.

In the fiscal year 2022-23, the agriculture sector in Pakistan experienced a growth rate of approximately 1.55%, which is significantly lower than the 4.27% growth observed during the same period the previous year. According to the Economic Survey of Pakistan for 2022-23, important crops contributed 18.23% to the value addition in the agriculture sector and 4.18% to the GDP. Other crops made up 14.49% of the value addition in the agriculture sector and contributed 3.32% to the GDP (Economic Survey, 2023).

### *Livestock and Fisheries*

Out of the 22% contribution of agriculture to the GDP, livestock holds a significant share of 60%, providing employment to 35 million individuals involved in its production. Pakistan's primary livestock products include milk and dairy items, beef, mutton, poultry, and fisheries, as well as vegetables and fruits.

Pakistan has established self-sufficiency in livestock production. In fact, it ranks among the world's leading meat producers, achieving a total production of 3.9 million tons in the fiscal year 2021-22 (TDAP, 2023). The majority of this meat is domestically consumed, with only about 2% exported. Pakistan's annual milk production stands at an impressive 52.6 million tons. Additionally, the annual primary production of vegetables in Pakistan reaches 7.07 million tons, showing consistent growth at a rate of 3.5% per year.

### *Balance between Urbanization and Agriculture*

As per census data, 36.4% of the population resides in urban areas. Projections from the UN Population Division anticipate that by 2025, nearly half of the nation's population will live in urban regions. The process of urbanization is commonly linked with economic expansion, particularly in developed nations, where these two trends have historically advanced hand in hand. Globally, it is estimated that cities contribute to over 80% of the world's total GDP. Regions with higher levels of urbanization tend to exhibit increased per

capita income and greater employment opportunities. Furthermore, urbanization exerts a positive influence on technological innovation and fosters economic growth (Express Tribune, 2019).

### *Effective Land Utilization*

The management of natural resources is a challenge, particularly due to resource degradation, including soil health deterioration, grassland degradation, groundwater depletion, and the rapid withdrawal of water resources. Rapid urbanization has led to a shift in land use, transforming fertile lands into urbanized areas for residential and industrial purposes. Rural-to-urban migration is a primary driver of this rural transformation. Water resources are also under stress due to the high demand for food from an ever-growing population.

Per capita water availability has drastically decreased from 5,000 m<sup>3</sup> in the 1950s to less than 1,000 m<sup>3</sup> today. Out of the total 142 million acre-feet (MAF) of river flow, about 104 MAF is diverted to canals, of which approximately 57 MAF reaches the farm head. Canal water is supplemented with groundwater abstraction (50.3 MAF) through more than 1 million tube wells installed across the country, making water availability at the farm head around 108 MAF. However, 27 MAF is lost during field application, leaving only 81 MAF for crop consumptive use against a requirement of 102 MAF. Overuse of tube well water has resulted in groundwater depletion and saline water intrusion into the aquifer.

The untapped potential of about 19 MAF from hill torrents (Rod Kohi), if harvested, could bring about 7 million hectares under cultivation, distributed across Balochistan (67%), Khyber Pakhtunkhwa (13%), Punjab (8%), Sindh (8%), and FATA (4%).

### *Food Self-Sufficiency*

Pakistan is proficient in producing significant staple crops, ranking 8th in wheat, 10th in rice, 5th in sugarcane, and 4th in milk production. Despite this agricultural strength, UNICEF's *National Nutritional Survey 2018*, published in 2020, indicates that only 63.1% of Pakistani households enjoy food security. Of the remaining 36.9% classified as food insecure, 18.3% experience severe food insecurity.

According to the *Global Food Security Index 2023*, Pakistan ranks 84th among 113 countries. Conversely, the *Economic Survey of Pakistan* for the ongoing fiscal year reports an increase in per capita availability of pulses, meat, milk, and eggs. Although per capita calorie availability for 2022-23 has decreased to 2,567, it still exceeds the minimum calorie requirements of the general population.

Notably, Pakistan's *National Security Policy 2022* underscores the significance of food security as a paramount strategic concern.

### ***Food Availability and Accessibility***

Food availability encompasses the quantity of food accessible within a country, accounting for sources such as domestic production, imports, and existing food stocks. The Ministry of Food Security and Research (MNFSR) is responsible for monitoring food availability. To aid in this, MNFSR has developed a dashboard that provides regularly updated data on a crop-specific basis, including cultivated areas, domestic production, demand estimates, storage capacities, government procurement, and opening and closing stocks.

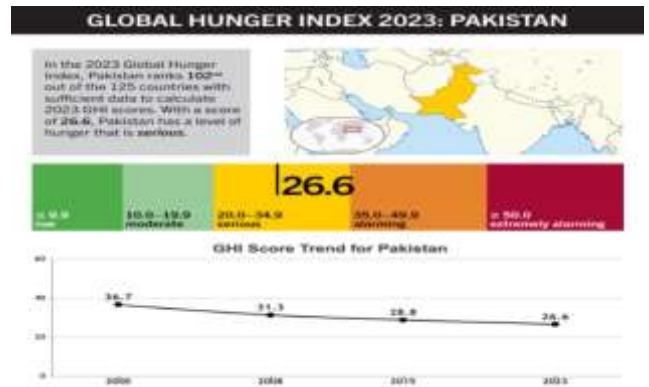
According to MNFSR data, Pakistan's annual wheat production stands at approximately 28 million tons, which falls short of the national requirement of around 32 million tons, resulting in a deficit of 4 million tons (*Grain, 2023*). Pakistan produces 6.5 million tons of sugar annually, surpassing the national demand of 6 million tons. In the case of rice, Pakistan produces 8.5 million tons, far exceeding the national requirement of 4 million tons.

### ***Hunger Definition***

According to the FAO, hunger is commonly defined as a discomforting or distressing feeling resulting from an inadequate intake of food energy. Scientifically, it is termed food deprivation. In simple terms, everyone experiencing hunger is considered food insecure, but not all individuals facing food insecurity experience hunger, as additional factors contribute to food insecurity.

### ***Global Hunger Index***

In the year 2023, Pakistan was placed 102nd out of 125 countries in the Global Hunger Index (GHI) with a score of 26.6. The GHI assessment indicates an improvement in Pakistan's food security situation when compared to previous years. However, it is important to note that Pakistan is still categorized as having a "Serious" level of hunger, signifying that the hunger situation in the country remains a matter of significant concern. (GHI, 2023)



## Population Growth

On the other hand, according to the first ever digital census of Pakistan the total population of Pakistan has reached at 241.49 million with an annual growth rate of 2.55%. (Statistics, 2023) and this dictates that Pakistan food security must be given its due attention by the policy makers of Pakistan.

### Inflation

Pakistan currently ranks 18th globally in terms of the impact of inflation, while grappling with significant socio-political challenges. By July 2023, the annual inflation rate had decreased to 28.3%, marking the lowest level since January 2023. Notably, food inflation remained relatively steady at 39.5% (Pakistan, 2023), despite nearly 40% of Pakistan's population living below the poverty line.

### Stakeholder Analysis

A stakeholder analysis of the *National Food Security Policy 2018* in Pakistan involves identifying and assessing the various individuals, groups, organizations, and entities that have an interest in or are affected by the policy. Key stakeholders and their roles include:

#### 1. Government Bodies:

- *Ministry of National Food Security and Research*: Responsible for policy development, coordination, and oversight of food security initiatives.
- *Provincial Agriculture Departments*: Implement and regulate policy measures at the provincial level.
- *Food Departments*: Manage food distribution and supply chain operations.

#### 2. Farmers and Agricultural Producers:

- *Large-Scale Farmers*: Influenced by policies on crop support prices, irrigation, and agricultural inputs.
- *Smallholder Farmers*: Directly affected by policies on access to credit, seed quality, and extension services.
- *Livestock Owners*: Impacted by policies related to animal health, fodder, and market access.

3. **Agribusiness and Private Sector:**
  - *Agro-Industry:* Food processors, seed companies, and agribusinesses affected by market access, trade regulations, and agricultural policies.
  - *Retailers:* Influenced by food safety, quality standards, and distribution policies.
4. **Research and Academic Institutions:**
  - *Agricultural Research Organizations:* Conduct policy-relevant research and provide data and expertise.
  - *Universities and Think Tanks:* Contribute to evidence-based policy formulation.
5. **Non-Governmental Organizations (NGOs) and Civil Society:**
  - *Advocacy Groups:* Promote food justice and advocate for marginalized communities.
  - *Social Welfare Organizations:* Address hunger and malnutrition at the grassroots level.
  - *Environmental NGOs:* Advocate for sustainable agricultural practices.
6. **Consumers and Food Security Advocates:**
  - *General Public:* Affected by food prices, availability, and safety.
  - *Food Security Advocates:* Promote food security as a policy priority.
7. **International Organizations and Donors:**
  - *United Nations Agencies:* Provide technical and financial support for food security initiatives.
  - *Foreign Donors:* Offer financial assistance for policy implementation and capacity building.
8. **Media and Communication Outlets:**
  - *Media Organizations:* Shape public opinion and disseminate information on food security issues.
9. **Environmental Agencies:**
  - *Environmental Protection Agencies:* Address sustainable agricultural practices, land use, and resource management.
10. **Healthcare and Nutrition Experts:**
  - *Nutritionists and Health Professionals:* Contribute to discussions on food quality and nutrition.

### 11. Climate and Weather Institutions:

- *Meteorological Agencies*: Influence policies on climate-resilient agriculture and disaster preparedness.

### 12. Multilateral Trade Agreements:

- *World Trade Organization (WTO)*: Shapes trade policies affecting food security through international agreements.

Stakeholder analysis facilitates understanding the interests, influence, and impacts of various groups, enabling the development of inclusive, effective, and equitable policies.

As a member of the United Nations, Pakistan is committed to achieving the Sustainable Development Goals (SDGs), particularly SDG 2 (*Zero Hunger*) and SDG 3 (*Good Health and Wellbeing*), with a target completion date of 2030. These goals are closely linked to food security.

### SDGs and Pakistan's Efforts

SDG 2 and SDG 3 aim to eliminate hunger, ensure food security, promote sustainable agriculture, and enhance the overall health and well-being of citizens. Pakistan has made considerable progress in these areas. Under SDG 3, the concept of Universal Health Coverage is emphasized.

One significant initiative is the *Benazir Income Support Program (BISP)*, with a budget of 471 billion PKR. This program includes:

- *Benazir Kafalat*: A cash transfer program initiated in 2008, benefiting 9.3 million recipients.
- *Benazir Nashonuma*: A program launched in 2016, focusing on maternal and child nutrition, reaching 0.91 million beneficiaries.

Collaborative efforts among governments, civil society, and international organizations are crucial to achieving sustainable food supplies and good health.

### GAP Analysis of Targets vs. Achievements in Major Crops

- **Sugarcane**: The target area for 2023-24 was 1.18 million hectares with a production target of 78.59 million tons. Provisional estimates indicate that cropped area and production were 0.7% and 0.1% below target, respectively, while yield increased by 0.6%.

- **Rice:** The FCA set a target of 3.07 million hectares with a production goal of 9.04 million tons. Estimates show the rice area increased by 9.3% to 3.35 million hectares, but production decreased by 4.4% to 8.64 million tons.
- **Maize:** The target production for 2023-24 was 7.56 million tons. Provisional estimates show maize production reached 10.3 million tons, 36.5% higher than the target.
- **Cotton:** The target area was 2.8 million hectares with a production target of 12.7 million bales. Cotton was sown on 2.4 million hectares, 13% less than the target (FCA, 2023).

Production Estimates (MMT)	Carry-forward Stocks (MMT)	Total Availability (MMT)	National Requirement (MMT)	Net Shortfall (MMT)
28.18	1.63	29.81	32.21*	2.40

Table-31: Estimated Wheat Shortfall

## SWOT analysis of agriculture sector of Pakistan

### Strengths

- **Diverse Agro-Climatic Zones:** Pakistan's geography allows for a wide range of crops to be grown throughout the year.
- **Large Workforce:** The sector employs a significant portion of the country's population, offering numerous employment opportunities.
- **Abundant Water Resources:** The Indus River system provides a crucial source of water for irrigation.
- **Agricultural Exports:** Pakistan exports various agricultural products, such as rice, cotton, and fruits, contributing significantly to the economy.
- **Government Support:** The government has historically provided subsidies, research facilities, and infrastructure development for the agriculture sector.

### Weaknesses

- **Outdated Farming Practices:** Many farmers in Pakistan still rely on traditional and less efficient farming techniques.
- **Water Management Issues:** Water scarcity and inefficient irrigation systems pose significant challenges.



- **Land Fragmentation:** Land is often divided into small, uneconomical plots, hindering modernization and mechanization.
- **Post-Harvest Losses:** Poor storage and transportation facilities result in significant post-harvest losses.
- **Lack of Education:** A lack of agricultural education and training in modern techniques limits progress.

### Opportunities

- **Technology Adoption:** Embracing modern agricultural practices, including precision agriculture and biotechnology, can boost productivity.
- **Export Growth:** Increasing exports of agricultural products to international markets can drive economic growth.
- **Value Addition:** Developing agribusiness and food processing industries can add value to agricultural products.
- **Crop Diversification:** Exploring new crops and value-added products can reduce reliance on a few key crops.
- **Sustainable Practices:** Implementing sustainable farming practices can address environmental concerns and enhance long-term viability.

### Threats

- **Climate Change:** Increasingly unpredictable weather patterns and natural disasters can disrupt crop production.
- **Pests and Diseases:** Pest infestations and plant diseases can result in significant crop losses.
- **Water Scarcity:** The decreasing availability of water resources poses a major threat to the sector.
- **Global Market Fluctuations:** International market fluctuations can impact the prices of agricultural exports.
- **Political Instability:** Political instability and policy changes can disrupt the agriculture sector.

### Institutional Analysis

An institutional analysis of Pakistan's agriculture sector involves examining the various organizations, government bodies, and entities that play key roles in shaping agricultural policies, practices, and outcomes.

1. **Ministry of National Food Security and Research**
  - Responsible for the overall coordination of policies related to agriculture and food security in Pakistan.

- Develops strategies to enhance agricultural productivity, ensure food safety, and promote sustainable practices.
- 2. **Provincial Agriculture Departments**
  - Each province has its own department responsible for implementing and regulating agricultural policies and programs at the provincial level.
  - Oversees crop management, pest control, and extension services.
- 3. **Pakistan Agricultural Research Council (PARC)**
  - The apex agricultural research organization in Pakistan, focusing on crop research, livestock, and agro-based industries.
  - Conducts research to improve agricultural practices and technologies.
- 4. **Agriculture Credit Institutions**
  - Development banks, such as Zarai Taraqiati Bank Limited (ZTBL), provide financial support to farmers through loans and credit facilities.
  - Help farmers access necessary funds for agricultural inputs.
- 5. **Pakistan Agricultural Storage and Services Corporation (PASSCO)**
  - Maintains strategic food reserves, ensures food security, and stabilizes food prices.
  - Manages the procurement and storage of grains.
- 6. **Pakistan Agricultural Research System (PARS)**
  - Comprises various agricultural research institutions and universities conducting research and development to enhance agricultural productivity and food security.
- 7. **Pakistan Council of Research in Water Resources (PCRWR)**
  - Focuses on water resource management critical for irrigation and agriculture.
  - Provides data and research on water quality and availability.
- 8. **Provincial Agriculture Marketing Boards**
  - Each province has a board responsible for regulating and promoting agricultural marketing.
  - Facilitates the marketing of agricultural produce.
- 9. **Pakistan Agriculture and Research Council (PARC)**
  - Acts as a platform for collaboration among public and private stakeholders in the agriculture sector.
  - Coordinates research, development, and extension activities.
- 10. **Pakistan Agricultural and Livestock Census Organization**
  - Conducts regular agricultural and livestock censuses to gather data on the sector's performance.
  - Provides data for policy formulation and resource allocation.

### 11. Provincial Agricultural Extension Services

- Each province has its own extension service to disseminate information and best practices to farmers.
- Plays a vital role in educating and training farmers.

Non-governmental organizations (NGOs) and international organizations also contribute to the development of Pakistan's agriculture sector. Institutional analysis is crucial for understanding the complex network of organizations influencing the sector's policies, practices, and outcomes, as well as identifying areas for improvement and reform.

## ANALYSIS OF ISSUES AND CHALLENGES

The research team's primary focus was on the agriculture sector, recognizing its pivotal role in shaping Pakistan's food security situation. At the "Agri Connections 2023" conference, Mr. Salim Raza, the former governor of the State Bank of Pakistan (SBP), emphasized the need for sustainable growth in the agriculture sector, targeting a 6% growth rate to drive essential economic expansion and job creation. He also highlighted the persistent stagnation in the agriculture sector's growth rate over time, which contributed to a trade deficit of \$5.5 billion in food and cotton imports during FY22. This trade deficit, in turn, worsened the current account deficit, which rose to \$17.4 billion in the same year (Tribune, 2023).

Below is a table providing a comparative analysis of growth rates across various sectors in Pakistan over the past several years.

Real GDP growth in five years period				
Fiscal Years	Agriculture	Industry	Services	GDP
FY2006- FY2011	2.2%	3.7%.	3.8%	4.6%
FY2011- FY2016	2.2%	3.7%	4.8%	4.0%
FY2016- FY2021	2.6%	1.4%	4.1%	3.2%

The table above provides an overview of Pakistan's real GDP growth rate components over a fifteen-year period. Notably, the agriculture sector emerges as a factor hindering overall growth. As a primary sector, agriculture should ideally stimulate economic growth across interconnected sectors and contribute significantly to the overall economy. However, during this timeframe, the growth rate in the agriculture sector remained relatively

stagnant, hovering at approximately 2.2% to 2.6% per annum. In contrast, the services and industrial sectors have been the driving forces behind the country's economic growth (Council, 2023).

The data strongly suggests the need to investigate the challenges faced by the agricultural sector to better understand its contribution to food insecurity in Pakistan.

Within the agriculture sector, it is worth noting that the livestock segment, particularly dairy and poultry, has played a significant role in driving agricultural growth. In contrast, the growth of the five major crops – wheat, cotton, sugarcane, maize, and rice – has been a restraining factor, with growth rates averaging around 1.1% per annum. This indicates that despite consuming a substantial share of Pakistan's agricultural resources, including land, water, and labor, these five crops have not delivered the expected output.

Real Agri GDP growth in five years				
Fiscal Years	Five Major Crops	Other crops	Livestock	Agri GDP
FY 2006-FY2011	1.2%	0.6%	3.0%	2.2%
FY 2011-FY 2016	1.1%	-1.1%	3.4%	2.2%
FY2016-FY 2021	1.1%	3.1%	3.0%	2.6%

The aforementioned scenario highlights that stagnant growth in the overall agriculture sector has been significantly hindered by the limited growth in the five-crop sector. This situation prompts the need for a more in-depth examination to uncover the underlying factors. To address this, the research team conducted interviews with authorities from the Ministry of National Food Security and Research and reviewed existing literature. The following factors undermining the performance of Pakistan's agriculture sector were identified:

#### ***Low Support Prices in Pakistan***

The agriculture sector generally faces challenges in profitability, as output prices often fall below the threshold that makes investment enticing. This issue is closely related to the availability dimension of food security. Traditionally, the government has attempted to tackle this problem by offering a minimum support price, often set at or below the cost of production. However, the Ministry of National Food Security and Research (MNFSR) has recently started establishing support prices for wheat that

provide a profit margin of approximately 25% above production costs (Dr. Akmal Siddiqi, 2023). In contrast, India provides a support price for wheat that offers a 50% margin to farmers, almost double that of Pakistan.

The minimum support price is set by the government to safeguard farmers' interests, ensuring that crops for which the price is established will be purchased by the government if unsold in the market. Ironically, Pakistan's minimum support prices for the past four to five decades have closely aligned with production costs, offering little incentive for farmers to cultivate wheat (Dr. Akmal Siddiqi, 2023).

Setting the minimum floor price presents its own challenges, as it must be announced at the beginning of the sowing season and requires consensus among all provinces. Differing provincial interests make this task complicated. Following the 18th constitutional amendment, the devolution of this subject to the provinces has made achieving consensus even more challenging, resulting in significant difficulties for the federal government in efficiently establishing the minimum floor price.

### ***Inadequate Focus on Agricultural Research and Development (R&D)***

A prominent factor contributing to growing food insecurity in Pakistan is underwhelming crop yields, often less than 50% of their potential. This deficiency largely stems from Pakistan's meager investment in agricultural research and development (R&D). Developing countries typically allocate about 0.56% of their agricultural GDP to agricultural R&D, emphasizing the pivotal role of research in the agricultural sector. In stark contrast, Pakistan allocates only 0.18% of its agricultural GDP to agricultural research, the lowest among South Asian nations. For comparison, India and China allocate 0.4% and 0.6%, respectively.

Developing countries usually dedicate around 40% of their total agricultural research budget to capital investment and operating costs. However, in Pakistan, this proportion has consistently remained at a low range of 10% to 20%. A significant portion of this budget is allocated to transportation and utilities.

The Pakistan Agricultural Research Council (PARC), an entity attached to MNFSR, is responsible for agricultural research and development. However, due to limited budget allocation, it has become largely ineffective. In 1980, PARC dedicated 56% of its budget to research, but this has dwindled to a mere 9% today. Chronic underfunding of agricultural research translates into lower crop yields compared to their economic potential, increased production costs, inflation, and ultimately reduced availability and accessibility of food commodities.

### ***Dysfunctional Agricultural Input Market***

Ineffective government involvement has resulted in a dysfunctional agricultural input market in Pakistan, particularly for seeds, fertilizers, and pesticides. Land ownership in Pakistan is highly skewed, with approximately 96% of farmers owning less than 12.5 acres of land (Dr. Akmal, 2023). These small-scale farmers face significant constraints, including limited access to formal credit, quality input and output markets, and modern agricultural technologies.

This situation leaves small farmers vulnerable to exploitative middlemen, known as *Aarhtis*, for liquidity needs. *Aarhtis* often provide financing in-kind, supplying agricultural inputs of compromised quality. Adulteration in seeds and fertilizers is prevalent, leading to significant losses in crop productivity and profitability. For instance, Pakistan's average wheat yield is less than 3 tons per hectare, which could potentially exceed 5 tons per hectare with improved input quality.

### ***Limited Access to Formal Credit for Farmers***

The skewed landholding pattern in Pakistan financially marginalizes a substantial portion of farmers who lack the collateral needed to secure agricultural credit from banks. This lack of financial inclusion for small farmers has cascading effects on food security. Farmers often turn to *Aarhtis* for financing, incurring exorbitant interest rates of 40% to 50%, compared to 20% to 25% charged by formal banks (Dr. Akmal, 2023). This financial burden not only inflates food prices but also influences farmers' crop choices, favoring oilseeds.

### ***Inefficient Farm Management***

Pakistan struggles with inefficiencies in farm management, with a notable disconnect between farmers and policymakers. Most farmers are illiterate and unaware of modern techniques and market dynamics. This lack of knowledge adversely affects crop productivity, as sowing, storage, and transportation practices are dictated by ad-hoc trends rather than strategic planning. For example, significant quantities of seeds are wasted due to improper sowing techniques, and inadequate storage facilities force farmers to sell crops at low prices to middlemen.

### ***Inadequate Supply of Certified Seeds***

Access to certified seeds is a significant challenge for agricultural productivity. Certified seeds are primarily available for major crops like wheat, rice, and cotton, while minor crops like fodder, pulses, and vegetables

lack certified seed availability (MNFSR, 2018). About 40% to 45% of wheat seeds are certified, and less than 30% of the area is sown with resistant varieties (MNFSR, 2023). This limited access is due to government indifference, inadequate R&D budgets, lengthy certification processes, and farmers' lack of awareness.

### ***Low Level of Mechanization***

Agricultural machinery usage in Pakistan is mostly confined to crop production. Farm power is estimated at 1.1 kW/ha, compared to 2.0 kW/ha in India and 5.7 kW/ha in China (MNFSR, 2018). Most tractors in Pakistan use outdated technology from the 1960s, requiring significant upgrades. Inefficient combine harvesters also result in a 10% grain loss.

### ***Food Wastage in Pakistan***

Food wastage impacts food security at every stage of the supply chain, from pre-harvest to consumption. Annual food wastage is estimated at \$4 billion (Nation, 2023). Inefficiencies, poor infrastructure, and limited agricultural technology are major contributors. Approximately 36 million tons of food are wasted annually due to these factors (Mughal, 2023).

### ***Climate Change Impacts on Food Security***

Climate change presents substantial risks to Pakistan's food security. Events such as the severe flooding in 2022 have caused significant agricultural damage, particularly in Sindh and Balochistan. Heatwaves, droughts, and other climate-related events exacerbate food insecurity, reducing crop yields and damaging infrastructure.

### ***Dependence on Imported Edible Oil***

Pakistan spends approximately \$4 billion annually on edible oil imports, draining foreign reserves. Non-standardized practices, such as cultivating non-approved canola varieties, further exacerbate this dependency.

Addressing these challenges requires comprehensive policies, substantial investment in R&D, infrastructure improvements, and collaboration between the public and private sectors to promote sustainable agricultural practices.

### ***Issues of Coordination After the 18th Amendment***

In 2008, the Ministry of Food, Agriculture, and Livestock was divided into two separate ministries: one focusing on food and agriculture, and the other on dairy development. Since the devolution of agriculture following the 18th

Constitutional Amendment, we do not intend to debate whether this decision was correct or not. Instead, our focus is on discussing the unintended consequences currently affecting the agricultural sector. The devolution has introduced a set of challenges. Firstly, it has created coordination issues between the federal government and the provincial governments. This has made it quite challenging for the MNFSR to establish a uniform and profitable support price, as they no longer have authority over this matter, which now falls under provincial jurisdiction. For instance, in 2022, MNFSR had to set the profitable support price for wheat at 3900/40 kg to align with the price of 4000/40 kg announced by the Sindh government, resulting in increased inflation in food products.

### **International Best Practices**

On the Food Security Index, Finland, Ireland, and Norway hold the first, second, and third positions globally, while at the regional level, China ranks 25th, India 68th, and Pakistan 84th. China and India have made significant strides in expanding food production and building sufficient safety stocks of food grains. Over the past 30 years, these countries have transitioned from being food-deficient nations to self-sufficient food producers. Over six decades, the governments of China and India have implemented a range of policies aimed at improving food security and addressing hunger.

### **National Food Security Act**

The National Food Security Act of 2013 in India ensures food and nutritional security by providing high-quality food at affordable prices. It is executed through a Central Grain Pool, implemented via the Targeted Public Distribution System, and monitored through an Internal Grievance Redressal Mechanism. The Act also supports the rights to health and nutrition, provides nutritional support for children and pregnant and lactating mothers, and emphasizes the prevention and management of malnutrition. It has strengthened India's Public Distribution System.

### **Initiatives to Improve Nutrition**

Due to the impact of various government initiatives, there has been a reduction in levels of child undernutrition over the last decade. Among these efforts, the Pradhan Mantri Matru Vandana Yojana (PMMVY) and the establishment of *Poshan Vatikas* at Anganwadi Centers are examples of programs aimed at enhancing nutritional status in India.



## Initiatives to Enhance Agricultural Output

The Indian government has implemented a range of programs to elevate the income and productivity of farmers. The country is geographically divided into 32 Crop Zones, and the Central Government determines the Central Issue Prices. Agricultural subsidies and schemes play a pivotal role in rural India, with the central authorities establishing Minimum Support Prices (MSPs) for 23 different agricultural commodities. Initiatives such as the Rashtriya Krishi Vikas Yojana and the National Food Security Mission offer subsidies for agricultural inputs, ensuring production costs remain competitive in international markets.

## Integration of Technology

India is strongly committed to expanding research and development within the country, focusing on encouraging the participation of the private sector. The nation is dedicated to enhancing agricultural productivity through the application of biotechnology, watershed management, nano-urea, and micro-irrigation.

## Lessons for Pakistan from India's Initiatives to Ensure Food Security

India has made substantial strides in addressing food insecurity, and Pakistan can draw valuable lessons from India's journey in this regard:

- **Investment in Research and Development:** Agriculture is a classic public good. Therefore, Pakistan, like India, needs to allocate a larger budget for research and development. Designing guidance and capacity-building programs for farmers is essential.
- **Functional Agricultural Markets:** To increase production, agricultural markets must be both functional and efficient. This applies to both input and output markets. India has established a robust monitoring mechanism to ensure discipline among market players.
- **Strong Political Commitment and Legislation:** A strong political commitment, supported by legislation similar to India's National Food Security Act of 2013, can streamline the process of ensuring food security in Pakistan.
- **Infrastructure Development:** India has made substantial investments in infrastructure, with plans to spend \$1.35 trillion to enhance market access, connectivity, and overall economic growth. Pakistan can consider similar investments.
- **Efficient Water Management:** Efficient water management is crucial. India has constructed numerous small, medium, and large water reservoirs to meet its water needs. Pakistan must focus on conserving and efficiently utilizing water to ensure food security.

## Regarding China's National Food Security

China ranked 34th in the Global Food Security Index in 2021 and improved to 25th in 2022 out of 113 countries. Like Pakistan, China also faces the threat of climate change affecting its food security. To address this, China has implemented a comprehensive set of measures:

- **Boosting Domestic Agricultural Production:** China provides support to farmers and modernizes agriculture to increase domestic production. This involves protecting arable land and promoting crop diversification.
- **Agricultural Research and Water Management:** Heavy investments are made in agricultural research and water resource management to enhance crop yields, ensure sustainable water use, and reduce dependence on a single staple crop.
- **Strategic Food Reserves and Price Regulation:** The government maintains strategic food reserves, regulates prices, and offers agricultural insurance to stabilize the market, benefiting both producers and consumers.
- **Diversified Import and Trade Policies:** Import and trade policies are diversified to ensure a stable food supply, reducing dependence on a single source.
- **Rural Development Initiatives:** Rural development initiatives aim to improve living standards and incomes for farmers.
- **Food Safety Regulations:** Stringent food safety regulations, poverty alleviation programs, and sustainable farming practices are integral parts of China's multifaceted approach to food security.

China recognizes the significance of food security for its large and growing population and has taken these measures to ensure a stable and sustainable food supply.

### *Conclusion*

Despite Pakistan primarily relying on agriculture as its economic backbone and maintaining sufficient production of essential food staples, it is increasingly facing food stress, primarily due to the affordability aspect of food security. Over the decades, successive governments have struggled to establish sustainable food security in Pakistan. The principal factors contributing to food stress in the country include limited investment in research and development, subpar crop yields, the use of low-quality inputs, the unavailability of certified seeds, dysfunctional agricultural input markets, farmers' restricted access to formal credit, water scarcity, a low level of agricultural mechanization, the impact of climate change, and food wastage.

This challenging situation demands urgent attention from Pakistan's policymakers to formulate and execute a comprehensive and strategic plan aimed at enhancing the availability, affordability, proper utilization, and climate adaptation of food resources. To sum up, we can say that while Pakistan faces significant challenges in ensuring food security, there are opportunities for improvement through strategic planning, investment, and community involvement. Addressing food security is crucial not only for the well-being of the population but also for the overall economic development and stability of the country. It requires a multifaceted approach that considers both short-term relief measures and long-term sustainable solutions.

### *Recommendations*

<b>Targets</b>	<b>Actions</b>	<b>Responsibility</b>	<b>Time lines</b>
Breast feeding and Sunny houses to overcome malnutrition	Ministry of National Health Media campaigns. Framing of rules and regulation	Government of Pakistan, PTA, CDA\KDA\LD A\PDA etc.	6 months 3 years
Timely announcement of support price and disbursement of payment to the farmers.	Implementation of existing policy and development of a legal framework for price fixation.	PM office, Council of Common Interest MNFSR Provincial Agriculture departments	03months
Provision of research based seed to improve yield.	Import quality seeds. Increase area for seed cultivation	MNFSR NARC	6 months 12 months
Timely Provision of Bardana	Implementation of existing provincial rules and policies	Provincial Government\ District Government	3 months
Population Control	Media campaigns \Implementation of existing rules and policies	Government \ Ulmas \ PTA	6 months
Framing of laws to Prevent food wastage.	Civic responsibility	Federal \ Provincial Governments	6 months
Ensure famers' access to formal credits	Generate National Registry of farmers for identity information SBP to develop program for extending formal credit lines to farmers by pledging the crops instead	SBP Commercial Banks Muccaddams NADRA	6 months

	of collateral		
Reduce wastages (pre-harvesting, transportation, consumption stage) of food	Educating farmers on modern farming techniques (precision) Develop linkages for transport Legislation and implementation for food saving at consuming end	MNFSR Provincial Agri department Provincial Assembles	12 months  5-8 years
Increase food storage capacities	Warehouses on lease Develop storage capacities of PASSCO	MNFSR PASSCO	6 months 12 months
Enhance Research and Development	Increase R&D budget from 0.2% to 0.4% of agriculture budget. Create agriculture endowment fund	Ministry of Finance MNFSR Provincial governments	03 months
Modern Mechanization	Import of farm machinery (tractors, planters, Reduce import duty on agriculture machines	FBR SBP	
GIS based Crop Zoning and Planning	Identification of crop zones areas each year w.r.t target/required production of each crop Climate resilient crop mapping through GIS	MNFSR, Provincial Agri dept, SUPARCO, PARC	03-05 Years

### **Comprehensive Implementation Design for Two Most Critical Recommendations:**

#### **Strict Prohibition of Cultivated Area for Real Estate:**

To protect agricultural land from the hands of real estate developers, there should be strict legislation on the protection of agricultural land after taking all stakeholders on board. It is a fact that the agriculture sector is less profitable, and real estate developers allure agricultural landowners with heavy amounts to grab their land for the construction of housing societies. Another factor is that real estate owners are so powerful and well-connected in the system of Pakistan that they even threaten landowners if they don't come to terms. Consequently, agricultural landowners sell their land either as a result of a heavy fortune or because they feel threatened. Now, it is the responsibility of lawmakers to legislate such laws to protect agricultural land from misuse for real estate purposes. After that, the executive/concerned

provincial government should enforce and enact such laws, and there should be continuous evaluation of the laws.

### **Soil Fertility Test Should Be Mandatory for Cultivation:**

Soil fertility testing is crucial for sustainable agriculture. To ensure the long-term productivity of cultivated lands and promote responsible land use, we recommend the implementation of mandatory soil fertility testing for all agricultural activities. This would involve developing accessible and affordable soil testing facilities to serve all agricultural communities. This may include government-supported labs and mobile testing units. To fulfill this purpose, education and data accessibility are very crucial. For instance, launch comprehensive awareness campaigns to educate farmers about the importance of soil testing, its benefits, and how to interpret test results. Establish a centralized database for storing and sharing soil test results, ensuring access for farmers, researchers, and policymakers to make informed decisions. Provide financial incentives, subsidies, or low-cost testing options to ease the economic burden on small-scale farmers.

Mandatory soil fertility testing will empower farmers with data-driven insights, reduce overuse of fertilizers, minimize environmental impacts, and improve crop yields, ultimately contributing to sustainable agriculture and food security.

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