

Examining The Challenges Leading to Low Crop Yields in Pakistan: Current Realities and A Roadmap for Agricultural Advancement

Musarrat Zaman¹

Mr. Jehanzeb Khan²

KJPP

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Abstract:

Agriculture is crucial for Pakistan, contributing 24% to the national GDP and employing 37.4% of the workforce, with over 70% of the population relying on it for income. Despite its significance, the sector faces severe challenges, including low crop yields driven by water scarcity, outdated farming practices, limited access to modern technologies, climate variability, inadequate infrastructure, and policy constraints. These issues undermine food security, exacerbate poverty, and increase income disparities. Addressing these challenges requires a multifaceted approach: improving water management, adopting climate-smart agricultural practices, enhancing soil health, and integrating advanced technologies. Strategic reforms and enhanced institutional support are vital to boost productivity and resilience. This research explores the root causes of low crop yields and suggests comprehensive solutions to advance agricultural practices. By proposing targeted interventions and policy changes, the study aims to contribute to sustainable development, food security, and rural prosperity in Pakistan.

Key words: Agriculture, Crop Yields, Water Scarcity, Climate Change, Policy Reform

¹ Currently posted as Additional Secretary, Minerals Development Department, Government of Khyber Pakhtunhwa.

² Faculty Advisor

Introduction

Pakistan is an agrarian economy where agriculture plays a pivotal role in sustaining livelihoods, ensuring food security, and driving economic growth. About 24% of the national GDP is supported by agriculture, while 37.4% of the labor force is engaged in agriculture (Pakistan Bureau of Statistics, 2023). More than 70% of the population relies either directly or indirectly on agriculture for a significant part of their income. About 47% of the national land is agricultural land. However, despite its significance, the agricultural sector in Pakistan faces numerous challenges, particularly regarding low crop yields. These challenges stem from a combination of factors, including, but not limited to, water scarcity, outdated farming practices, limited access to modern agricultural inputs and technologies, climate variability, inadequate infrastructure, and policy constraints (FAO, 2023).

Low crop yields in Pakistan not only endanger food security but also impede socio-economic progress, fueling poverty, migration, and income disparities. Traditional farming methods leave agriculture vulnerable to natural disasters and market fluctuations. Addressing these challenges requires a deep understanding of farming practices, water management, and market dynamics, culminating in evidence-based policy reforms and technological innovations to enhance agricultural productivity and resilience.

Through this research endeavor, it is envisaged to contribute to the broader goal of enhancing food security, promoting rural development, and fostering inclusive agricultural growth in Pakistan. By addressing the underlying causes of low crop yields and charting a path towards agricultural advancement, the research aims to catalyze transformative changes in the agricultural sector, thereby unlocking its full potential as an engine of sustainable development and prosperity.

Statement of Problem

The agricultural sector in Pakistan, despite its significance as a primary contributor to the national economy, is facing the challenge of low crop yields. This issue not only poses threats to the country's food security but also weakens economic resilience. Understanding the intricate factors contributing to these low yields is crucial for formulating targeted interventions and developing a comprehensive roadmap for sustainable agricultural growth.

This paper attempts to devise an effective roadmap for agricultural development. To achieve this, a thorough examination and study of the current realities are necessary. Furthermore, this research aims to identify practical and context-specific solutions, including the integration of technology, climate-resilient farming techniques, improved water management strategies, and policy reforms that collectively contribute to

sustainable agricultural development, analyzing the main causes of low crop yields in Pakistan and recommending a way forward.

Review of Literature

Water Scarcity

Kirby et al. (2017) examined Pakistan's water usage, population dynamics, food production, and security, revealing a stark reality: despite adequate wheat production, over half the population faces food insecurity, with 47% experiencing calorie deficiencies. Unequal food access and dependence on irrigation exacerbate this issue. As the population grows, so does the demand for food, necessitating increased production or imports to maintain current security levels (Ahmad and Farooq, 2010).

Numerous studies underscore Pakistan's agricultural challenges, including poor crop productivity and irrigation inefficiency. Wheat productivity significantly lags behind India and California, with the flood irrigation system causing substantial water losses, especially impacting small-scale farmers. Water scarcity exacerbates these issues, prompting recommendations for resilience improvement (Khan, 2014; Watto and Muger, 2016; Basharat, 2019; Young et al., 2019).

With over 90% of food production reliant on irrigation (FAO, 2016), Pakistan faces decreased per capita water availability due to population growth, leading to groundwater overexploitation and water quality threats (Condon et al., 2014). Addressing these challenges necessitates strategies proposed by various studies, such as developing new dams, enhancing water productivity, and improving governance (WSTF, 2012; Condon et al., 2014).

Climate change further compounds water availability issues, impacting crop yields. Adaptive measures, including adjusting sowing dates and intensifying research for high-yielding crop varieties, offer potential mitigation strategies (Sultana et al., 2009; Zhu et al., 2013; Rehman et al., 2015; Gorst et al., 2018). Pakistan's agrarian economy underscores the critical role of its agriculture sector in sustaining livelihoods and security (Munir et al., 2021).

Climate Change

Iqbal et al. (2009) highlight climate change's profound impact on agricultural productivity. Elevated temperatures shorten the growing period and crop life-cycle, resulting in yield losses, particularly in rain-fed wheat areas. Climate-induced alterations in river flows exacerbate water scarcity and contribute to land degradation. Extreme climate events disrupt farming operations, emphasizing the need for resilient agricultural practices to safeguard food security and livelihoods.

Research analyzing global climate models (GCMs) indicates significant shifts in regional and global precipitation and air temperature, likely impacting groundwater recharge. Projections indicate that climate change will lead to significant alterations in rainfall patterns, river flows, and sea levels globally

over the next century, posing substantial risks to agricultural yields (Ali et al., 2017). This increase in climate variability is acknowledged as a global anomaly with potentially enduring consequences, marked by more frequent occurrences of extreme weather events (Stern, 2008). Developing countries, despite contributing only 10% of annual global CO₂ emissions, are disproportionately vulnerable to the impacts of climate change (Maskrey et al., 2007). The reliance of many South Asian countries on agrarian economies makes them particularly susceptible to these climatic shifts, posing serious threats to their social, economic, and ecological systems (Ahmed & Schmitz, 2011). The World Bank's South Asia Climate Change Strategy highlights that the poorest will suffer most from climate change, especially those dependent on climate-sensitive incomes (Ali et al., 2017).

Pakistan's vulnerability to climate change is heightened by its diverse weather conditions and ecological challenges. With agriculture pivotal to the economy and employment, climate-related impacts like temperature rise, droughts, and floods pose significant risks. Urgent measures are necessary to mitigate these effects and protect livelihoods in the face of extreme weather events (Ali et al., 2017).

Land Degradation and Deforestation

Land degradation significantly hampers agricultural productivity, food security, and rural livelihoods in many developing countries, including Pakistan (FAO, 2006). Around 40-75% of global agricultural land suffers reduced productivity due to degradation, affecting approximately 1.5 billion people worldwide (Jolejole-Foreman et al., 2012; Bai et al., 2008). Unsustainable land practices and deforestation worsen environmental challenges, including biodiversity loss and climate change impacts, emphasizing the urgent need for mitigation efforts (Hussain, 2022).

Pakistan's arid landscape, vital for rural livelihoods, suffers from severe land degradation due to unsustainable practices and resource demands, worsening environmental issues and rural poverty. Urgent sustainable land management is crucial to mitigate threats like water scarcity and deforestation, ensuring future welfare. Farmers, vulnerable to natural uncertainties, contribute to poverty. Hindered by limited consultation, effective planning and technology adoption are impeded (Khan et al., 2013; Farooq et al., 2008). Lal (2018) underscores challenges in managing soil and water resources due to improper practices and climate change. Despite agricultural productivity growth, doubling food production by 2050 demands improved yields amid rising drought stress. Soil degradation and desertification, exacerbated by harsh climates, pose significant challenges, worsened by a growing population and uncertain climate. Soil erosion, highlighted since Harold Glover's report in 1941, remains a pressing concern, particularly in Punjab province (Khan et al., 2012).

Pests and Diseases

The Food and Agriculture Organization (FAO, 2019) has issued alarming statements concerning crop loss attributable to pests. It estimates that pests contribute to a reduction in global crop production ranging from 20% to 40%. Additionally, further losses occur during the post-harvest phase and distribution, as well as at the consumer level.

Crop health confronts mounting challenges from climate change, pests, and insufficient agricultural responses (CABI, 2016). Despite recognizing that pests cause about 40% of yield losses, data tracking remains limited. Initiatives like the Global Burden of Crop Loss aim to quantify these losses, aiding decision-makers in tackling food security and economic impacts. Crop pathogens and pests significantly reduce yield and quality, undermining food security globally. Regional disparities underscore the need to prioritize crop health management for sustainable agroecosystems (Savary et al., 2019). Wheat, vital for Pakistan's agriculture, faces threats from various pests, necessitating sustainable pest control measures to minimize yield losses (Hussain et al., 2022).

Cotton is vital to Pakistan's economy, contributing 7.8% to agricultural value addition and meeting 55% of domestic cooking oil needs. However, it faces challenges from numerous insect pests and diseases, causing yield losses of 20–40%. Effectively managing these pests remains a significant challenge for agricultural experts and growers (Karar et al., 2020). Khan et al. (2023) revealed significant yield reduction in tomatoes due to pests like cutworms, whiteflies, and leaf miners, despite mitigation efforts. Barasa et al. (2019) supported these findings.

Technological and Knowledge Gaps

The term "technology" refers to the application of knowledge and tools for achieving specific goals and economic objectives (Masood et al., 2012). In the context of agriculture, this entails striving for enhanced productivity through the adoption of innovative and modern agricultural techniques. However, in Pakistan, the majority of farmers rely on outdated traditional agricultural methods, leading to diminished land productivity (Sattar, 2012).

Small-scale farmers in impoverished regions often resort to traditional farming methods (Ali, 2010), resulting in meager crop yields despite increased investment in inputs and fertilizers (Khan, 2012; Sattar, 2012). The prevalence of traditional practices stems from a lack of awareness and access to modern farming technologies, compounded by poverty and the high costs associated with modern equipment (Jhangir et al., 2007).

Lack of awareness and poverty contribute to challenges faced by farmers in adopting modern agricultural technologies aimed at enhancing land productivity. Many farmers remain uninformed about these technologies, and poverty acts as a significant barrier, limiting their access to modern advancements (Phillip et al., 2009; Sattar, 2012). Additionally, small land

holdings pose a considerable obstacle to the adoption of modern agricultural practices (Sattar, 2012).

Despite successful innovations like laser land leveling (LLL), zero tillage, and high-efficiency irrigation systems, their widespread adoption encounters obstacles. Laser land leveling increases crop yield by 20%, and zero tillage by 12-15% (Ahmad, 2009). Barriers include financial constraints, high costs, limited access, small land holdings, and a preference for traditional practices (Jehangir et al., 2007). Although modern technology holds promise for agricultural productivity, its adoption remains slow among Pakistani farmers. Scaling up requires practical policy measures like better equipment supply, field demonstrations, and financial support, alongside promoting local manufacturing with private sector involvement (Rehman et al., 2015).

Methods and Materials

Interviews and Focus Group Discussions

In-depth interviews with key stakeholders provided valuable insights into the intricacies of agricultural practices and challenges.

Field Observations

Field visits to farmers' fields facilitated first-hand observation of farming practices. This direct observation allowed for the documentation of agricultural techniques employed by farmers. Moreover, qualitative insights were gathered through keen observation and interaction with farmers.

Comparative Analysis

A comparative analysis of agricultural practices and policies was conducted to identify areas for improvement. This analysis involved reviewing case studies and reports from comparable agricultural systems worldwide, with a focus on applicability to the specific context of Pakistan.

Expert Consultations

Engagement with agricultural experts, researchers, and scholars enriched the understanding of complex agricultural issues. Their opinions and expertise on potential solutions and strategies were sought, which was instrumental in devising effective interventions for improvement.

Dimensions of Low Crop Yield in Pakistan

When analyzing the challenges contributing to low crop yields (as highlighted for major crops in Table 1 & Fig. 1) in Pakistan, several dimensions emerged, each impacting the country's complex agricultural landscape. One significant dimension revolves around agricultural practices and technology. Outdated farming methods and limited adoption of modern agricultural technologies hinder productivity, necessitating a shift towards

innovative techniques, mechanization, and precision agriculture to enhance crop yields. Understanding the intricate factors contributing to these low yields is crucial for formulating targeted interventions and developing a comprehensive roadmap for sustainable agricultural growth (analysis of agricultural growth for the previous decade has been summarized in Table 2 & Fig. 2).

Water management is crucial for Pakistan's agriculture, but inefficient systems, water scarcity, and poor management exacerbate yield limitations. Solutions include adopting water-saving technologies like drip irrigation and improving infrastructure to optimize water usage. Soil health and land degradation also impact crop yields. Soil erosion, salinization, and nutrient depletion degrade soil quality, posing challenges. Strategies involve soil conservation practices, promoting organic farming, and combating land degradation to rejuvenate soil health and enhance yields. Climate change resilience is vital for crop yields. Increasing climate variability and extreme weather events threaten production, requiring climate-resilient crop varieties and smart agricultural practices for sustainable yields despite changing conditions.

Pests and diseases management is crucial for improving crop yields. Integrated pest management, bio-pesticides, and disease surveillance are needed to control outbreaks and minimize losses. Access to inputs and credit is vital, especially for smallholder farmers. Limited access to quality seeds, fertilizers, pesticides, and credit constrains farmers' ability to optimize yields. Strengthening input supply chains, providing financial support, and enhancing access to credit and extension services are essential to empower farmers and improve crop yields.

These challenges underscore the multifaceted nature of low crop yields in Pakistan, requiring comprehensive strategies and interventions to promote sustainable agricultural development.

Table 1. Production of Important Crops (000 Tonnes)

Year	Cotton (000 bales)	Sugarcane	Rice	Maize	Wheat
2014-15	13,960	62,826	7,003	4,937	25,086
	-	-	-	-	-
2015-16	9,917	65,482	6,801	5,271	25,633
	(-29.0)	(4.2)	(-2.9)	(6.8)	(2.2)
2016-17	10,671	75,482	6,849	6,134	26,674
	(7.6)	(15.3)	(0.7)	(16.4)	(4.1)
2017-18	11,946	83,333	7,450	5,902	25,076
	(11.9)	(10.4)	(8.8)	(-3.8)	(-6.0)
2018-19	9,861	67,174	7,202	6,826	24,349
	(-17.5)	(-19.4)	(-3.3)	(15.7)	(-2.9)
2019-20	9,148	66,380	7,414	7,883	25,248

	(-7.2)	(-1.2)	(2.9)	(15.5)	(3.7)
2020-21	7,064	81,009	8,419	8,465	27,293
	(-22.8)	(22.0)	(13.6)	(7.4)	(8.1)

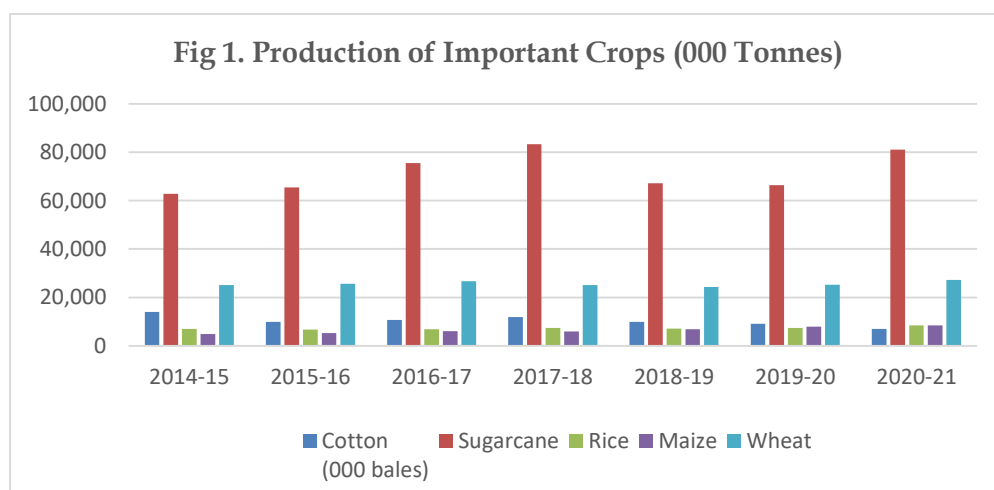
Note: Figures in parentheses are growth/decline rates

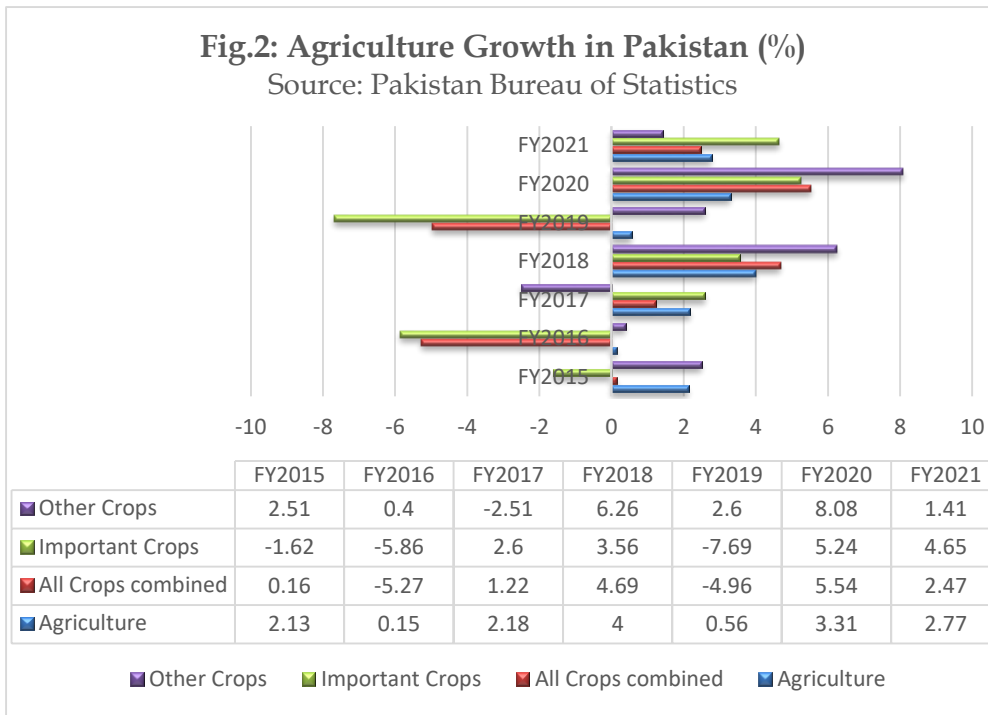
Source: Pakistan Bureau of Statistics

Table 2. Agriculture Growth

Sector	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021
Agriculture	2.13	0.15	2.18	4	0.56	3.31	2.77
1.Crops (i+ii+iii)	0.16	-5.27	1.22	4.69	-4.96	5.54	2.47
i) Important Crops	-1.62	-5.86	2.6	3.56	-7.69	5.24	4.65
ii) Other Crops	2.51	0.4	-2.51	6.26	2.6	8.08	1.41
iii) Cotton Ginning	7.24	-22.12	5.58	8.8	-12.74	-4.82	-15.58
2.Livestock	3.99	3.36	2.99	3.7	3.82	2.1	3.06
3.Forestry	-12.45	14.31	-2.33	2.58	7.28	3.6	1.42
4.Fishing	5.75	3.25	1.23	1.62	0.8	0.6	0.73

Source: Pakistan Bureau of Statistics





Major Challenges Leading to Low Crop Yields in Pakistan

In Pakistan, challenges to low crop yields mirror global issues, including water scarcity, climate change, soil degradation, outdated farming practices, infrastructure gaps, pests and diseases, limited access to credit and inputs, and socio-economic factors. Research has thoroughly examined and identified these challenges, leading to the development of a roadmap with potential solutions. To enhance crop yields, a comprehensive approach is needed, involving sustainable water management, climate-smart agriculture promotion, modern farming practices adoption, rural infrastructure investment, and improved access to credit and education for farmers. Overcoming these obstacles requires concerted efforts through government policies, international collaborations, and community engagement.

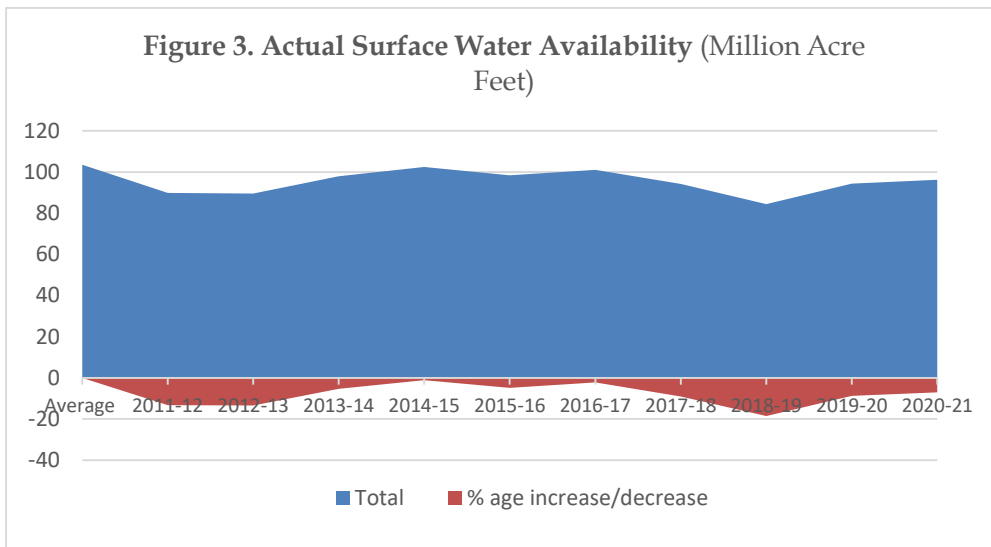
Water Scarcity

Water scarcity challenges Pakistan's agriculture, reducing crop yields due to heavy reliance on irrigation. Water availability has always been a problem in the country; the decrease in average system usage has been summarized in Table 3 and Fig. 3.

Table 3. Actual Surface Water Availability (Million Acre Feet)

Period	Kharif	Rabi	Total	% age increase/decrease
Average	67.1	36.4	103.5	0

system usage				
2011-12	60.4	29.4	89.8	-13.2
2012-13	57.7	31.9	89.6	-13.4
2013-14	65.5	32.5	98	-5.3
2014-15	69.3	33.1	102.4	-1.1
2015-16	65.5	32.9	98.4	-4.9
2016-17	71.4	29.7	101.1	-2.3
2017-18	70	24.2	94.2	-9
2018-19	59.6	24.8	84.4	-18.5
2019-20	65.2	29.2	94.4	-8.8
2020-21	65.1	31.2	96.3	-7



Source: Indus River System Authority

Following are some of the water scarcity-related reasons for low crop yield:

1. Pakistan heavily relies on the Indus River for irrigation, but water availability is often inadequate due to climate variability, reduced glacial melt, and inefficient water management practices.
2. Inefficient water use and management practices contribute to wastage.
3. Aging irrigation infrastructure leads to water losses and uneven distribution.
4. Changing climate patterns result in irregular rainfall, affecting water availability.
5. Over-extraction of groundwater leads to a declining water table.
6. Increasing population puts additional pressure on water resources for domestic and industrial use, impacting agriculture.

Climate Change:

Climate change poses challenges to global agriculture, impacting Pakistan with erratic rainfall, rising temperatures, and extreme weather events, leading to low crop yields. Coping requires a comprehensive approach involving research, policy, innovation, and community engagement for resilience and food security. Reasons outlined below:

1. Changes in rainfall patterns, including irregular timing and intensity, can lead to water stress and drought conditions during critical crop growth stages.
2. Rising temperatures can accelerate crop maturation, reduce crop duration, and increase heat stress on crops, leading to reduced yields.
3. Climate change can create favorable conditions for the proliferation of pests and diseases, leading to increased infestations and crop damage.
4. Climate change exacerbates water scarcity issues, reducing water availability for irrigation and crop production.
5. Changes in temperature and precipitation patterns can alter traditional growing seasons, affecting crop phenology and reducing yields.
6. Climate change contributes to soil erosion, salinization, and degradation, reducing soil fertility and agricultural productivity.

Soil Degradation:

Low crop yield in Pakistan due to soil degradation can be attributed to various factors. Soil degradation refers to the decline in soil quality and fertility, which adversely affects agricultural productivity. Here are some reasons for low crop yield in Pakistan related to soil degradation:

1. Wind and water erosion can lead to the loss of topsoil, reducing soil fertility.
2. Continuous monocropping.
3. Excessive and improper use of chemical fertilizers.
4. Excessive irrigation in arid regions can lead to the accumulation of salts in the soil.
5. Poor drainage systems can lead to waterlogging.
6. Clearing forests for agriculture can lead to the loss of organic matter and disrupt the ecosystem balance.

Outdated Farming Practices:

Low crop yield in Pakistan due to outdated farming practices can be a significant challenge, as traditional methods may not be as efficient or sustainable in modern agricultural contexts. Here are some reasons for low crop yield in Pakistan related to outdated farming practices:

1. Reliance on traditional and inefficient irrigation methods can lead to uneven water distribution and water wastage.
2. Traditional plowing methods cause soil erosion, damage to soil structure, and increased vulnerability to water and wind.
3. Relying on the cultivation of a single crop over large areas can deplete soil nutrients and increase the risk of pest and disease outbreaks.
4. Lack of adoption of modern agricultural technologies and machinery can hinder efficiency and productivity.
5. Farmers may use traditional or low-quality seeds, limiting crop potential.
6. Improper post-harvest handling practices can result in significant losses.

Infrastructure and Technology Gaps:

Low crop yield in Pakistan due to infrastructure and technology gaps can significantly impact the efficiency and productivity of the agricultural sector. Here are some reasons for low crop yield in Pakistan related to these gaps:

1. Traditional manual methods or outdated machinery can be inefficient and labor-intensive.
2. Lack of communication infrastructure in rural areas can hinder the timely dissemination of information on weather forecasts, market prices, and agricultural practices.
3. Inadequate post-harvest infrastructure, including storage facilities and transportation networks, can result in significant crop losses.
4. Limited awareness and knowledge about modern agricultural technologies and practices can hinder their adoption.
5. Insufficient investment in agricultural research and development can impede the introduction of new and improved crop varieties and technologies.
6. Power shortages can affect the operation of irrigation systems and limit the use of modern agricultural machinery.

Pests and Diseases:

Low crop yield in Pakistan due to pests and diseases is a significant concern for agriculture. Several factors contribute to this issue, and implementing effective pest and disease management strategies is essential. Here are some reasons for low crop yield in Pakistan related to pests and diseases:

1. Planting the same crop repeatedly in a given area can create a favorable environment for pests and diseases to thrive.
2. Lack of regular monitoring and early detection systems can result in delayed response to pest and disease outbreaks.
3. Overreliance on chemical pesticides without considering ecological and biological factors can lead to resistance and environmental issues.

4. Farmers may not have access to crop varieties that are resistant to prevalent pests and diseases.
5. Improper water management practices, such as over-irrigation, can create conditions conducive to certain diseases.
6. Changes in temperature and precipitation patterns can influence the prevalence and distribution of pests and diseases.

Limited Access to Credit and Inputs:

Limited access to credit and inputs can significantly impact crop yields in Pakistan in the following ways. Several factors contribute to this issue, and addressing them is crucial for improving agricultural productivity:

1. Farmers may face challenges in securing loans or credit for purchasing seeds, fertilizers, pesticides, and other essential inputs.
2. The cost of agricultural inputs, including seeds, fertilizers, and pesticides, may be high, making them unaffordable for small-scale farmers.
3. Traditional lending institutions may require collateral, which many smallholder farmers may not possess.
4. Some farmers may lack the financial knowledge needed to navigate the credit application process.
5. Poor infrastructure in rural areas can limit the reach of financial institutions and hinder the delivery of credit and inputs.
6. Farmers may hesitate to invest in inputs due to market uncertainties and price volatility.

Socio-economic Factors:

Socio-economic factors play a crucial role in influencing agricultural productivity and crop yield in Pakistan. Addressing these factors is essential for sustainable agricultural development. Here are some reasons for low crop yield related to socio-economic factors in Pakistan:

1. Inheritance practices often lead to the subdivision of agricultural land, resulting in small and uneconomical farm sizes.
2. Widespread poverty in rural areas can limit farmers' capacity to invest in quality inputs and modern farming practices.
3. Poor health conditions can affect the labor productivity of farmers, leading to lower crop yields.
4. Insufficient infrastructure, including roads, transportation, and market facilities, can hinder the efficient movement of agricultural produce.
5. Farmers may adhere to traditional methods due to cultural norms, lack of exposure, or resistance to change.
6. Limited access to credit can constrain farmers from making necessary investments in inputs and technology.

Pakistan's Agriculture Policy Gap Analysis

One significant policy gap in Pakistan's agriculture policy that hinders the advancement of agriculture is the lack of effective implementation and enforcement mechanisms. Despite the existence of various policies and strategies aimed at promoting agricultural development, there is often a gap between policy formulation and implementation on the ground. This gap can be attributed to several factors:

1. Governmental bodies lack resources and expertise to implement agricultural policies effectively.
2. Lack of collaboration among departments and stakeholders leads to disjointed efforts.
3. Political instability: Changes in leadership disrupt policy implementation, affecting long-term planning and investment in agriculture.
4. Insufficient mechanisms hinder progress evaluation, impeding evidence-based policy adjustments.
5. Smallholder farmers struggle to access credit, inputs, and technology due to ineffective policies.
6. Policies often fail to address farmers' needs and local challenges effectively, creating a disconnect between intent and reality.

Roadmap for Agricultural Advancement

To advance agriculture in Pakistan and improve overall agricultural productivity, a comprehensive roadmap is essential on the following aspects:

Water Management and Irrigation:

- Upgrade and modernize the irrigation system to reduce water wastage and improve efficiency.
- Invest in water storage facilities and dam construction to address water scarcity issues.
- Promote efficient water-use practices, such as drip and sprinkler irrigation.

Climate-Smart Agriculture:

- Implement climate-resilient farming practices to mitigate the impact of climate change.
- Introduce drought-tolerant and heat-resistant crop varieties.
- Encourage the adoption of agroforestry to enhance resilience and carbon sequestration.

Soil Health Improvement:

- Promote sustainable soil management practices, including organic farming and cover cropping.

- Conduct soil health assessments and provide farmers with information on appropriate soil amendments.
- Implement conservation agriculture techniques to prevent soil erosion and degradation.

Technology Adoption:

- Provide farmers with access to modern agricultural technologies, including precision farming, satellite imaging, and mobile applications for farm management.
- Promote the use of genetically modified crops that are resistant to pests and diseases.
- Facilitate training programs to educate farmers on the use of new technologies.

Infrastructure Development:

- Improve rural infrastructure, including roads, storage facilities, and market access.
- Establish cold storage facilities to reduce post-harvest losses.
- Upgrade transportation networks to facilitate the efficient movement of agricultural products.

Research and Development:

- Invest in agricultural research to develop high-yielding crop varieties adapted to local conditions.
- Support research on innovative farming techniques, sustainable practices, and biosecurity measures.

Extension Services and Farmer Education:

- Strengthen extension services to provide farmers with up-to-date information and best practices.
- Establish farmer training centers to enhance agricultural skills and knowledge.
- Promote agricultural education at all levels to ensure a knowledgeable farming community.

Access to Credit and Inputs:

- Facilitate access to credit for smallholder farmers through government programs and financial institutions.
- Subsidize agricultural inputs such as seeds, fertilizers, and pesticides to make them more affordable.

Policy Support and Governance:

- Formulate and implement farmer-friendly policies that address the needs of diverse agricultural communities.
- Establish regulatory frameworks to ensure the sustainable use of natural resources and promote responsible agricultural practices.
- Encourage public-private partnerships to attract investment in the agricultural sector.

Conclusion

The analysis highlights some major challenges contributing to low crop yields in Pakistan, encompassing systemic, environmental, socio-economic, and technological dimensions. Water scarcity and irrigation issues, exacerbated by inefficient management practices and climate change impacts, emerge as critical obstacles. Soil degradation, pests, diseases, and limited access to inputs and technology further hinder productivity enhancement efforts. Moreover, socio-economic disparities, policy and governance challenges, and market access barriers exacerbate the situation, undermining agricultural sustainability and rural livelihoods. Addressing these challenges requires a holistic approach that integrates sustainable water management, climate-resilient agriculture, soil conservation, technology adoption, policy reforms, and institutional capacity building.

Recommendations

- Implement water-efficient cropping patterns to mitigate water scarcity and improve irrigation efficiency.
- Invest in water infrastructure upgrades and promote water-saving irrigation techniques.
- Develop climate-smart agricultural practices, including drought-resistant crop varieties, agroforestry, and rainwater harvesting, to enhance resilience to climate change impacts.
- Implement soil conservation measures to combat soil degradation and restore soil fertility.
- Strengthen pest monitoring and surveillance systems and promote integrated pest management approaches.
- Facilitate access to modern agricultural technologies specifically for small landholders.
- Enact policy reforms to prioritize sustainable practices, incentivize innovation, and address socio-economic disparities in access to resources and markets.
- Enhance the capacity of agricultural extension services, research institutions, and farmer cooperatives to provide technical support, training, and knowledge dissemination to farmers.

- Improve market infrastructure, reduce trade barriers, and establish fair trade practices to enhance farmers' access to markets, promote price stability, and diversify income sources.
- Initiate joint ventures and public-private partnerships to bring a large chunk of uncultivated lands under corporate farming.

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