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CURRENT SITUATION AND FUTURE PROSPECTS OF WHEAT PRODUCTION IN PAKISTAN

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Abstract *Wheat is Pakistan's most important staple food crop and is vital to the country's food security and economy. Pakistan is the eighth-largest wheat producer in the world, and wheat contributes about 14% to the country's gross domestic product (GDP). Wheat is a major source of calories and nutrition for the Pakistani population. It is the most widely consumed grain, and Pakistan's per capita wheat consumption is among the highest in the world. The wheat sector also employs a significant number of people in Pakistan. It is estimated that about 45% of the country's population is directly or indirectly associated with agriculture, and wheat is the most important crop grown by small farmers. The wheat sector thus plays a crucial role in poverty alleviation and rural development. Moreover, the wheat sector also significantly impacts Pakistan's economy. Wheat is the largest agricultural commodity traded in the country, and its production and trade contribute to foreign exchange earnings and the country's overall economic growth. Wheat is important to Pakistan's economy, food security, and livelihoods, and its sustainable production and productivity are critical for the country's overall development.*

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Introduction

Wheat is Pakistan's most important cereal crop, covering about 80% of the total cropped area, and is a staple food for most of the population. According to the Food and Agriculture Organization (FAO, 1996), Pakistan is the 8th largest wheat producer in the world, producing approximately 25 million metric tons of wheat annually. The country's wheat production increased significantly, from 19.5 million metric tons in 2014 to 25.5 million in 2020 (FAO, 2021). Pakistan's wheat production is concentrated in the Punjab province, which contributes about 70% of the country's total wheat production, followed by Sindh province, which contributes about 20% (Government of Pakistan, 2021). The increase in wheat production is largely due to the expansion of the cultivated area, which increased from 8.9 million hectares in 2014 to 9.4 million hectares in 2020 (FAO, 2021). Despite the increase in wheat production, Pakistan still faces many challenges in ensuring food security and self-sufficiency. One of the major challenges is the low productivity of wheat crops, which is significantly lower than other wheat-producing countries. The average wheat yield in Pakistan is around 3.0 metric tons per hectare, much lower than the global average of 3.5 metric tons per hectare (FAO, 2021). The low productivity of wheat crops in Pakistan can be attributed to several factors, including poor soil fertility, inadequate water management, lack of access to high-quality seeds and fertilizers, and limited use of modern agricultural techniques (Ahmed et al., 2021). In addition, wheat crops in Pakistan are vulnerable to a range of biotic and abiotic stresses, such as pests, diseases, droughts, and heatwaves (Elahi et al., 2011; Munir et al., 2020). The Pakistani government has launched various initiatives to address these challenges, increase wheat productivity, and ensure food security. These include the provision of subsidized fertilizers and seeds to farmers, the establishment of wheat research centers, and the development modern irrigation systems (Government of Pakistan, 2021). In conclusion, wheat production is a crucial sector of Pakistan's economy and is vital in ensuring food security for the population. While the country has made significant progress in increasing wheat production, there is still a need for further improvements in productivity and resilience to ensure sustainable and reliable wheat production in the future.

Agricultural policy and wheat production in Pakistan

Pakistan is an agricultural country where more than 60% of its population depends on agriculture for their livelihood. Agriculture is the backbone of the country's economy, and wheat is the most important staple crop, contributing significantly to Pakistan's national food security (Ashfaq et al., 2021). Over the years, the government of Pakistan has introduced various policies to support the agriculture sector, including wheat production. The Wheat Productivity Enhancement Program (WPEP) was launched in 2015 to increase wheat production in the country by improving seed quality, providing credit facilities, and enhancing mechanization (Awan et al., 2019). However, implementing agricultural policies in Pakistan has been marred by corruption, political influence, and bureaucratic hurdles (Ahmad & Ahmad, 2020). The lack of transparency and accountability in the implementation of policies has led to a significant gap between policy intentions and outcomes (Saleem et al., 2018). Moreover, the farmers in Pakistan face various challenges in wheat production, including water scarcity, low-quality seeds, and inadequate infrastructure (Nadeem et al., 2020). The government's failure to address these issues has resulted in low wheat yields and lower incomes for farmers (Rai et al., 2016). Various initiatives have been proposed to address these challenges, such as promoting modern technologies, precision agriculture, and providing better irrigation facilities (Babar et al., 2018). Additionally, promoting value-added wheat products, such as pasta, can help increase the demand for wheat and improve farmers' incomes (Imran et al., 2018). In conclusion, wheat production is crucial for Pakistan's food security and economy, and the government needs to introduce more transparent and accountable policies to support the agriculture sector. Additionally, initiatives addressing farmers' challenges can help improve wheat yields and farmers' incomes, thereby contributing to the country's overall development (Singh et al., 2007).

Production and yield trends of wheat in Pakistan

Wheat is an important crop in Pakistan as a food source and a cash crop. Pakistan is one of the largest producers of wheat in the world, with an average annual production of over 25 million metric tons (Ahmad et al., 2019). The wheat production in Pakistan has increased steadily, from 14.8 million metric tons in 2000-01 to 25.5 million metric tons in 2018-19 (FAO, 2021). One of the key factors contributing to the increase in wheat production in Pakistan is the adoption of modern farming techniques and technologies. For example, high-yielding wheat varieties, improved irrigation practices, and better pest management strategies have all contributed to increased yields (Akhtar et al., 2015). The government of Pakistan has also implemented various policies and programs to support wheat farmers, such as subsidies for inputs like fertilizers and seeds (Tariq et al., 2018a). Despite these efforts, wheat yields in Pakistan are still relatively low compared to other wheat-producing countries (Ahmad et al., 2019). One of the main reasons for this is that wheat is grown in various agroecological zones across the country, each with its unique challenges (Gill et al., 2017). In addition, small-scale farmers who make up a significant portion of wheat growers in the country often lack access to the necessary resources and information to maximize their yields (Ahmad et al., 2019). To address these challenges, there is a need for continued investment in research and development (Munir et al., 2020). Research efforts could focus on developing new wheat varieties better suited to Pakistan's diverse agroecological zones and improving soil health and water management practices (Tariq et al., 2018b). Additionally, improved extension services could help provide farmers with the latest knowledge and technologies, including precision agriculture tools and techniques (Ahmad et al., 2019).

Factors affecting wheat production in Pakistan

Wheat is an important crop in Pakistan and a major food source for its population. However, the country faces several challenges in increasing wheat production and improving crop yield (Khan et al., 2019). Wheat production in Pakistan is influenced by various factors such as water availability, soil fertility, temperature, pest and disease management, and inputs such as seeds and fertilizers (Akhtar et al., 2016). Water is a crucial input for wheat production, and Pakistan is primarily an irrigation-based agricultural economy. However, water availability in the country is limited due to climate change, population growth, and overuse of water resources (Munir et al., 2020). Climate change has also increased temperatures, negatively affecting wheat growth and yield (Ashfaq et al., 2016). In addition, soil fertility is a critical factor in wheat production, and many regions in Pakistan suffer from soil degradation and nutrient depletion, which can lead to lower yields (Akram et al., 2018). Another major challenge in wheat production is pest and disease management. Wheat crops in Pakistan are susceptible to various pests and diseases, such as rust and aphids, which can cause significant yield losses if left unmanaged (Ullah et al.,

2019). Lack of knowledge and access to effective management strategies also contribute to these losses. Access to inputs such as high-quality seeds and fertilizers is also essential for increasing wheat productivity in Pakistan. However, small-scale farmers, who make up a significant portion of wheat growers in the country, often lack access to these resources due to affordability issues and limited availability in remote areas (Ahmed et al., 2016). Furthermore, there is a need to promote high-yielding varieties and better seed production techniques to improve wheat productivity (Amin et al., 2017). To address these challenges, the government of Pakistan has implemented various policies and programs, such as the Prime Minister's Agriculture Emergency Program, which aims to improve access to inputs and promote sustainable farming practices (Qureshi et al., 2020). Additionally, there is a need for continued investment in research and development to develop new wheat varieties resistant to pests and diseases, drought-tolerant, and high-yielding (Mahmood et al., 2019). Furthermore, promoting sustainable agriculture practices such as conservation and precision farming can help improve soil fertility and water use efficiency (Imran et al., 2021).

Wheat farming practices and challenges in Pakistan

Wheat farming is a crucial component of Pakistan's agricultural sector, contributing significantly to the country's food security and economy. However, the wheat farming sector in Pakistan faces numerous challenges that hinder its growth and development. One of the primary challenges is the lack of access to modern agricultural inputs and technologies, such as high-quality seeds, fertilizers, and irrigation systems, which significantly affects wheat yields (Mahmood et al., 2017). Another significant challenge is climate change, which has led to erratic weather patterns, including unpredictable rainfall and prolonged droughts. These weather patterns have reduced wheat yields, causing significant losses for farmers (Khan et al., 2020). Furthermore, the degradation of soil fertility due to the overuse of chemical fertilizers and intensive farming practices is another critical issue that affects wheat productivity (Akhtar et al., 2018). Poor post-harvest handling and storage practices also pose significant challenges to the wheat farming sector in Pakistan. Improper storage facilities and practices lead to post-harvest losses, reducing the farmers' incomes and the country's wheat supply (Ullah et al., 2019). The prevalence of pests and diseases such as rust and smut also contribute to reduced wheat yields (Tariq et al., 2018b). To overcome these challenges, various initiatives have been undertaken by the government and private sector to improve wheat farming practices in Pakistan. These include the introduction of high-yielding varieties of wheat, the provision of subsidies for agricultural inputs, and the promotion of sustainable farming practices (Khan et al., 2020). Additionally, modern technologies such as precision farming, remote sensing, and artificial intelligence are being promoted to enhance wheat productivity (Mahmood et al., 2017). Despite these efforts, several challenges remain, such as limited access to credit facilities and market information, inadequate extension services, and the lack of support for small-scale farmers. Addressing these issues is critical to the growth and development of the wheat farming sector in Pakistan (Akhtar et al., 2018).

Wheat processing and distribution in Pakistan

There has been a significant shift in how wheat is processed and distributed in recent years, with modern technologies and a growing focus on value-added products (Khan et al., 2019). Traditionally, wheat processing in Pakistan has involved manual labor and small-scale mills, which are often inefficient and produce low-quality flour (Khan et al., 2019). However, in recent years, there has been a trend towards larger, more modern mills that use advanced technologies like roller milling and automated quality control systems to produce high-quality flour (Ali et al., 2017). Despite these advancements, there are still challenges facing the wheat processing industry in Pakistan. For example, wheat farmers' quality can vary widely, making it difficult for mills to produce consistent, high-quality flour (Saleem et al., 2018). Additionally, the high cost of energy and raw materials and limited access to financing can make it difficult for small and medium-sized mills to compete with larger players in the market (Ali et al., 2017). In terms of distribution, the wheat flour market in Pakistan is highly fragmented, with many small-scale retailers and wholesalers operating in local markets (Tariq et al., 2018a). However, there has been a growing trend towards larger, more centralized distribution networks, which can help to improve efficiency and reduce waste (Khan et al., 2019). To address these challenges and further improve Pakistan's wheat processing and distribution industry, there is a need for increased investment in research and development and greater collaboration between industry players, government agencies, and other stakeholders (Saleem et al., 2018). Additionally, policies supporting modern technologies and best practices, such as energy efficiency and waste

reduction, could help improve the industry's overall sustainability (Ali et al., 2017).

Role of research and development in wheat production

Research and development (R&D) plays a critical role in improving wheat production, as it helps to identify and develop new technologies and practices that can increase yields and improve the overall efficiency of wheat farming (Islam et al., 2018). One of the key areas of R&D in wheat production is the development of new high-yielding wheat varieties adapted to local growing conditions (Ganeshan et al., 2018). These varieties are often developed using modern biotechnology tools, such as genetic engineering and marker-assisted selection (MAS) (Kumar et al., 2015). In addition to variety development, R&D in wheat production also focuses on improving agronomic practices such as tillage, fertilization, and pest management (Kumar et al., 2013). This includes the development of precision agriculture technologies, which can help farmers apply inputs and manage their crops more accurately (Hussain et al., 2020). Another important area of R&D in wheat production is the development of climate-smart technologies and practices that can help farmers adapt to the impacts of climate change (Munir et al., 2021). While R&D has been critical in improving wheat production over the past few decades, many challenges still need to be addressed. One of the main challenges is the limited investment in agricultural R&D, particularly in developing countries (Prashanth et al., 2008). This has led to a lack of resources and infrastructure, which can impede the development and dissemination of new technologies and practices. Another challenge is farmers' limited adoption of new technologies and practices, even when available (Namdev et al., 2018). This is often due to lack of awareness, limited access to information and inputs, and risk aversion (Bijman et al., 2018). To overcome these challenges, there is a need for increased investment in extension services, which can help to disseminate new technologies and practices and provide farmers with the necessary information and support (Ahmad et al., 2021). The R&D is critical in improving wheat production and ensuring food security for the growing global population. However, many challenges need to be addressed to realize the potential of R&D in this area fully. This includes increasing investment in agricultural R&D, improving the dissemination of new technologies and practices, and addressing the social and economic factors hindering farmers' adoption of new technologies.

Wheat quality and market demands in Pakistan

Wheat is an important crop in Pakistan and a major food source for the country's population. The quality of wheat produced in the country is crucial in meeting the market demands for various wheat-based products (Hussain et al., 2019). The quality of wheat is influenced by various factors, including genotype, environment, and management practices (Farooq et al., 2019). In recent years, there has been a growing demand for high-quality wheat in Pakistan, particularly for producing bread, biscuits, and other bakery products (Akram et al., 2018; Mehboob et al., 2011). This has led to an increased focus on improving the quality of wheat produced in the country regarding physical and chemical attributes (Marya et al., 2020). One of the key factors affecting wheat quality in Pakistan is the prevalence of various diseases and pests, such as rust and aphids, which can significantly reduce yield and quality. To address this issue, there is a need to develop resistant wheat varieties and adopt integrated pest management strategies. Another important aspect of wheat quality is the presence of mycotoxins, which can harm human health and affect the quality of wheat-based products (Khan et al., 2021). To minimize the risk of mycotoxin contamination, there is a need to implement good agricultural practices, such as proper storage and handling of wheat, as well as appropriate fungicides and other control measures (Munir et al., 2019; Raza et al., 2015ab).

In addition to quality, market demands also play a crucial role in determining the wheat types produced in Pakistan. For example, there is a growing demand for specialty wheat varieties, such as durum wheat, for pasta and other similar products (Saeed et al., 2007). Appropriate breeding programs and management practices are needed to meet these demands to optimize yield and quality for specific wheat varieties (Farooq et al., 2011; Singh et al., 2005). Overall, producing high-quality wheat in Pakistan is critical for meeting market demands and ensuring food security for the country's population. Achieving this goal will require a coordinated effort from various stakeholders, including farmers, researchers, and policymakers, to address the various challenges and opportunities related to wheat quality and market demands (Masood et al., 2014; Ahmad et al., 2020; Rizwan et al., 2020).

Economic impacts of wheat production in Pakistan

Wheat is an essential crop for Pakistan's economy, as it is a staple food source of income for millions of people involved in its production and marketing. In 2019-20, Pakistan produced over 25 million tonnes of wheat, making it one of the top ten wheat-producing countries in the world (Government of Pakistan, 2021). The economic impacts of wheat production in Pakistan are significant at the national and regional levels and can be analyzed from various perspectives. One of wheat production's most important economic impacts is its contribution to the country's gross domestic product (GDP). According to a study by Ali et al. (2021), the wheat sector contributes around 2.0% to Pakistan's GDP and provides employment opportunities to around 45% of the country's labor force. The same study estimates that the total value-added generated by the wheat sector is around PKR 1.6 trillion, equivalent to around 4.0% of the country's GDP. Another economic impact of wheat production is its role in the country's trade balance. Pakistan is a net wheat exporter, and the surplus production is exported to other countries, generating valuable foreign exchange earnings. According to the Ministry of National Food Security and Research (2021), Pakistan exported over 600,000 tonnes of wheat in 2020-21, earning approximately USD 135 million. However, the country also imports wheat to meet its domestic demand, and the import bill can significantly burden the national economy (Nadeem et al., 2020).

Wheat production also has significant regional impacts, particularly in rural areas where most wheat is grown. A study by Qureshi et al. (2018) found that wheat cultivation contributes significantly to rural livelihoods, generating employment opportunities for both men and women and providing a source of income for small-scale farmers. However, the study also highlights that the benefits of wheat production are not equally distributed, with some regions and groups experiencing more significant gains than others. Finally, the economic impacts of wheat production are not limited to its direct contributions to GDP and trade balance. Wheat is also an important input for many other industries, such as the food processing industry, which generates additional economic activity and employment opportunities (Ali et al., 2021; Ali and Malik, 2021). Moreover, the production and marketing of wheat require various services and inputs, such as transportation, storage, and financing, which generate additional economic activity in rural and urban areas.

Future prospects and recommendations for wheat production in Pakistan

Wheat is a staple crop in Pakistan, and its production is critical in ensuring food security for the country's population. However, despite being one of the world's largest wheat producers, Pakistan still faces significant challenges in achieving sustainable and competitive wheat production (Akhtar et al., 2015). To address these challenges, there is a need for continued investment in research and development, as well as improved extension services, to provide farmers with the latest knowledge and technologies (Munir et al., 2020; Sarwar et al., 2022).

One promising area of research is developing high-yielding wheat varieties better adapted to local agroecological conditions (Ali et al., 2019). Precision agriculture technologies, such as remote sensing and geographic information systems, can also help farmers optimize their use of inputs like water and fertilizer, improving yields and reducing environmental impacts. In addition to these technological solutions, there is a need for policies that incentivize sustainable farming practices and support small-scale farmers who make up a significant portion of wheat growers in the country (Ahmad et al., 2020). For example, programs that provide farmers access to credit, inputs, and markets can help improve their livelihoods and productivity (Ghaffar et al., 2016). To further improve wheat production in Pakistan, there is also a need for greater collaboration and knowledge-sharing among stakeholders in the wheat value chain (Ali et al., 2019). This includes partnerships between farmers, researchers, policymakers, and private sector actors to develop and implement innovative solutions to the wheat sector's challenges. Achieving sustainable and competitive wheat production in Pakistan will require a holistic approach that addresses the complex social, economic, and environmental factors that influence the sector (Hussain et al., 2018). With the right investments, policies, and partnerships, Pakistan has the potential to become a global leader in wheat production and contribute to global food security (Ali et al., 2021).

In conclusion, Pakistan's wheat production and yield trends have seen significant progress over the years, making the country one of the largest wheat producers in the world. However, several challenges still need to be addressed to ensure sustained growth and development of the wheat industry (Munir et al., 2020; Ali et al., 2013). One of the main challenges is the relatively low yields compared to other wheat-producing countries, which can be attributed to various factors, including limited access to resources

and information for small-scale farmers (Ahmad et al., 2019). Improving extension services to provide farmers with the latest knowledge and technologies to maximize yields is essential to overcome this. Continued investment in research and development is also necessary to ensure the adoption of modern farming techniques and high-yielding wheat varieties (Ali et al., 2014). Another significant challenge facing Pakistan's wheat industry is climate change, resulting in reduced wheat productivity and an increased risk of pests and diseases (Munir et al., 2020). To mitigate the effects of climate change, it is crucial to develop and implement adaptation strategies, such as using drought-tolerant wheat varieties and improved irrigation techniques (Munir et al., 2020).

In addition, there is a need for policies that incentivize farmers to adopt sustainable farming practices and technologies, such as conservation agriculture, which can help increase yields while promoting environmental sustainability (Ahmed et al., 2021). The government can also support wheat farmers by providing subsidies for inputs like fertilizers and seeds and implementing price stabilization policies to ensure farmers receive a fair price for their produce (Akhtar et al., 2015; Ali et al., 2016). Furthermore, the wheat industry in Pakistan has significant potential for growth and expansion in international markets. The country can take advantage of its strategic location and cost-competitive production to increase exports of wheat and wheat-based products (Ara et al., 2009). This can be achieved by improving wheat products' quality and value-added and implementing trade policies that support exports. In summary, the wheat industry in Pakistan has made significant progress over the years, but there is still much that needs to be done to ensure sustained growth and development. Improved extension services, continued investment in research and development, and adoption of sustainable farming practices and technologies are necessary to increase yields and ensure environmental sustainability. The government can also support the industry through subsidies and price stabilization policies while focusing on improving the quality and value of wheat products, which can help increase exports and expand the industry's potential in international markets.

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Declarations

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All data generated or analyzed during the study are included in the manuscript.

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Not applicable

Consent for publication

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Conflict of Interest

Regarding conflicts of interest, the authors state that their research was carried out independently without any affiliations or financial ties that could raise concerns about biases.