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Keywords: Climate Change, Rainfall Pattern, Wheat, Maize, Crop Production, Crop Diseases

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Title

Influence of Changing Rainfall Patterns on Wheat and Maize Production: A Case Study of Mandra District, Rawalpindi

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Contents

Abstract

This study highlights the influence of irregular rainfall on Wheat and Maize Production in Mandra, District Rawalpindi, Pakistan. Local farmers face many difficulties due to the change in climate. Farmers used to grow pulses and peanuts, but now these crops are not grown due to climate change. Through in-depth interviews, the study highlights that changes in rainfall patterns result in crop diseases like leaf Rust, Stem Rust, insects, and damage. The study also shows that rising costs of fertilizers like DAP, Urea, and pesticides lead to financial stress for farmers. Findings show that climate change affects crop productivity and farmers' lives. The study recommends a better irrigation system and offering discounts for fertilizers and pesticides; accurate information about weather and providing awareness to farmers can reduce the influence of changing rainfall patterns on Wheat and Maize Production. It can help farmers to reduce losses in the future.

Keywords:

Climate Change, Rainfall Pattern, Wheat, Maize, Crop Production, Crop Diseases

Introduction

Pakistan is an agricultural country with fertile land and diverse seasons, and it relies heavily on farming for its economy and livelihoods. Wheat and maize are key crops sensitive to water availability and are mostly rain-fed. However, climate change has caused irregular rainfall, affecting traditional farming practices and crop production. This creates challenges for farmers in planning and protecting their crops. South Asia, including Pakistan, depends on monsoon rains for crop production, but changes in these patterns due to rising temperatures and pollution have increased water

scarcity and food insecurity. Understanding how rainfall changes impact wheat and maize production is important for developing adaptive strategies.

In the past, people used to grow crops based on seasons and regular rainfall. Farmers planned their farming according to weather patterns. These farming methods are passed down from generation to generation. However, due to climate change, these methods are not working. Farmers face many difficulties in protecting their crops because of irregular weather patterns. (Feng et al., 2021)

More than half of the population of this world depends heavily on wheat. Wheat a source of energy for people, making it one of the most important food crops in the world. But due to unpredictable and extreme patterns of rainfall caused by climate, the growth of wheat is in danger. According to scientists, in the future, Rain will fall less frequently but in heavier bursts, which can be the greatest challenge for farmers. A study was carried out using various soil types to observe how the crop responds to changing rainfall conditions to gain a better understanding of how this will affect wheat. The findings demonstrated that in the future, due to changing rainfall patterns, the wheat yield, size, and growth will most probably decrease in sandy soils with poor nutrient retention.

Regions such as South Asia, Sub-Saharan Africa, and some parts of Latin America are experiencing shifts in monsoon onset and wet seasons, which result in droughts in some areas and floods in other areas. These droughts and floods threaten the stability of the agricultural system and create a hindrance in the production of wheat and Maize properly due to unpredictable rainfall. (Kaium et al, 2025)

South Asia depends a lot on the rainy season called the Monsoon. If the Monsoon comes late or brings too much or too little rain, it can harm the crops, especially wheat and Maize, which are sensitive to water availability. Most of the people of South Asia depend on farming for their survival, so when the rainfall patterns change, it deeply affects their lives. Rise in temperature and pollution are also changing monsoon patterns. (Fiaz et al., 2025)

Researchers in Kenya discovered that maize production is changing in regions with less consistent weather, such as semi-arid and semi-humid zones. Farmers may need to use faster-maturing varieties and plant maize earlier in order to adapt. Indeed, scientists have found that our crops become more vulnerable the more we rely on high-yield crop varieties and set farming schedules. One of the most important food crops in the Czech Republic is maize, and like many other regions of the world, climate change is having an impact on its growth.(Kipkulei et al., 2025)

The study examined the effects of climate change-related variations in rainfall on maize (corn) yields in three provinces: KwaZulu-Natal, Northwest, and Free State, between 1987 and 2017. By using the official data, researchers discovered that maize yields were negatively impacted by changing rainfall patterns, either by too much or too little rain. For instance, the Northwest Province saw significant decrease in crop production overall due to the dry conditions, even though a little more rain helped. However, maize farming wasn't as severely impacted in KwaZulu-Natal, while large commercial farms play a significant role in the economy of the nation, many small-scale farmers rely on growing crops as their primary source of income and food for their families. Farming is among the first industries to experience the consequences of changing climate patterns because harvests are so reliant on the weather. Understanding how the atmosphere is changing and developing more accurate projections for the future makes it equally crucial to research how crops will be impacted by these changes and how farmers can adjust.

This study examines Chile's maize and wheat production to determine how future yields may be impacted by rising temperatures and shifting rainfall. Using HadCM3 global model climate projections and crop growth computer models, the study indicates a 5 to 10% decline in the productivity of Maize. The best solution for irrigated maize was to shift the planting dates. In contrast, winter wheat would suffer significantly more in a "no-change" scenario; however, it also benefits from increased CO_2 levels, so careful farming practices can significantly counteract the harm caused by a hotter, drier climate.

The study showed a “learn-as-you-go" strategy, which shows that farmers modify their choices, such as when to plant or how much water to use for crops, in response to past crop performance, rather

than depending on a single set plan. As the climate changes gradually, this adaptable approach helps farmers to stay close to the highest possible profits by following strict schedules based on historical norms and far-off projections.

This study examined the effects of shifting rainfall patterns on maize production in Nigeria's Benue State, specifically in the Gboko Local Government Area. The researchers found that the quantity and frequency of rainy days had a significant positive effect on maize yields after examining 30 years' worth of rainfall and crop yield data. Put simply, farmers were able to harvest more maize when there was more consistent rainfall. Rainfall is a critical component of crop success in this area, as the analysis also revealed that patterns of rainfall accounted for more than 67% of the variations in maize yield. The study created a model to forecast maize yield in addition to shedding light on the connection between farming and rainfall. For many small-scale farmers, farming is their primary source of income. It also contributes significantly to the national economy, particularly in areas with robust commercial agriculture. Agriculture has been a primary focus of research on the effects of climate change because crop growth is extremely sensitive to weather patterns. More focus is being placed on how climate change will affect crops and what farmers can do to adapt as scientists gain a better understanding of the atmosphere and make more accurate predictions.

Problem Statement

Rainfall plays an important role in the growth of crops (Wheat and Maize). However, rainfall patterns have changed due to the changing climate. Sometimes, there is too much rain, and sometimes, there is very little rain. This change in rainfall patterns affects the growth of crops badly. Farmers face many difficulties in protecting their crops. This research aims to study how the changes in rainfall patterns are affecting the production of Wheat and Maize in Mandra, District Rawalpindi.

Research Objectives

1. To understand the influence of changing rainfall patterns on wheat and maize production.
2. To explore the methods that farmers use to reduce the effect of irregular rainfall

Research Questions

1. How does changing rainfall affect how much wheat and maize farmers can grow?
2. How do farmers deal with unpredictable or irregular rainfall when growing wheat and maize?

Importance of Study

Wheat and Maize are two important food crops in Pakistan; many farmers rely on rainwater to grow them. When the rainfall is too little or too much, it can harm the crops. This is a big problem in some places where farmers do not use canals or tube wells. By studying how changing rainfall affects the production of crops, we can understand the problems that farmers face in farming and find simple ways to help them, like using better farming methods or saving water.

Study Approach

For this study, the data was collected through field visits and interviews with local farmers and agricultural experts in Mandra, District Rawalpindi. I observed how changes in rainfall patterns affect Wheat and Maize Production. I reviewed some literature to support my findings.

Review of Literature

Studies show that Climate Change, especially changes in rainfall patterns and rises in temperature, has a terrible impact on the production of crops in Pakistan. Studies show that the production of wheat and sunflower decreases due to heat stress and irregular weather patterns. Studies highlight that there is a need for adaptation to climate change to ensure food security. (Ali et al., 2021)

Studies highlight that the production of Maize depends on rainwater in many parts of Pakistan, so it is badly affected by changes in rainfall patterns. Maize production increased at first when temperatures rose, but later, too much heat and irregular rainfall impacted the crops badly. (Rasheed and Sadozai, 2024)

Studies show that changes in climate, like rainfall, drought, floods, and rises in temperature, have a severe impact on agriculture. These weather changes make food production difficult and reduce

crop yields, threatening food security. Farmers face many difficulties. Studies also show that those farmers who are experienced and educated are better at managing these difficulties. There is a need for better policies and support to reduce these issues. (Ali et al., 2017).

Climate change affects the farming, impacting the crop yields and resource use. Wheat is a very important crop for most of the people worldwide. Due to changes in rainfall, Wheat production is affected badly. Studies have highlighted that the production of wheat will decrease due to rainfall conditions. The type of soil also plays a very important role in how wheat responds to the changes in Climate. Some soil limits the growth of crops, and some helps them to grow properly. (Tataw et al., 2016)

Studies demonstrated that in Pakistan, Climate change impacts wheat production. Rise in temperature and changing in precipitation patterns the yield of crops and food security. Studies show that heavy rainfall results in waterlogging and soil erosion, which disturbs the productivity of the crops. Improving water management techniques and sustainable farming practices are very important to improve the productivity of crops. (Janjua & Samad, 2022)

Researchers examined the major crops in India and found that average precipitation influences the wheat and Maize yields in both the long and short run. They reported that maximum temperature and rainfall had favorable impacts on the productivity of crops, whereas minimum temperature often has a negative impact on the crops. Rainfall in moderate amounts supports the productivity, whereas heavy rainfall damages the crops badly. (Choudhary & Gupta, 2024)

Long-term changes in temperatures and weather patterns brought on primarily by human activity are referred to as climate change. The effects of rising global temperatures over the past century are now evident in both human life and the natural world. To comprehend and handle this worldwide issue, significant international organizations such as the IPCC and UNFCCC were established. Fast-growing economies in the developing world are now contributing more to emissions due to rising consumption, even though wealthy countries have slowed their development. This demonstrates that combating climate change is an international issue that requires cooperation from both developed and developing countries. The research study is significantly shaped and guided by the literature review. It aids in the researcher's comprehension of previous research, methodologies, and knowledge gaps. With an emphasis on industries like education and transportation, this chapter has examined the idea of accountability, particularly social accountability, and its relationship to the provision of public services. (IPCC, 2022)

Frontiers assessed the trends of climate in the regions of Sindh and Punjab in Pakistan from 1990 to 2022 and found a significant increase in annual patterns of rainfall about 100 to 300 mm in Punjab and 30 to 60 mm in Sindh, especially in the season of monsoon season, while precipitation og winter results in a decline in rain-fed zones. A rise in rainfall patterns can improve water availability, but it also increases the risks of floods and waterlogging during the sowing period of wheat. The result shows that changes in the patterns of rainfall may degrade the fertility of soil and threaten the crop yield, which also affects the livelihoods of many people. (Frontiers, 2023)

Materials and Methods:

Site

Data was collected from Mandra, located in the northern part of District Rawalpindi. Mandra is located along the historic GT road and is a small city that offers a unique blend of cultural heritage and advanced services. The city was also known as ''The City of Rajputs'' in ancient times.

Sample

The Sample size was 30. (Farmers and Agricultural experts).

Respondent

Respondents were local farmers and Agricultural experts of Mandra.

Methodology

An exploratory research methodology was used in this study to collect data from farmers and experts to gain a deeper understanding of the topic.

Study Design

A qualitative study design was used in this study, which included in-depth interviews with farmers.

Tool

An interview guide was used as a tool for data collection in this study.

Data Source

The source of data was Local farmers and some experts in agriculture & farming.

Research Methodology

In this study, a qualitative research method was used to collect non-numeric data from 30 participants in Mandra, District Rawalpindi. The qualitative research method provides farmers' personal experiences, thoughts, and perspectives. I chose the method of in-depth interviews because, through in-depth interviews, participants can express their views openly and in detail. Open-ended questions helped me understand the topic in detail. In-depth interviews are a powerful method for exploring people's experiences and thoughts. The opinions of farmers and agricultural experts were also focused in this study. The main tool which was used in this study was Interview guide.

Results and Discussions

Data was collected from the 30 farmers in Mandra, District Rawalpindi. Results show that changes in rainfall patterns badly affect wheat and maize production. Farmers reported that there is very little rain, which leads to dry fields and poor crop growth. Farmers also said that increased diseases like leaf rust, stem rust, insect attacks, and weeds are making productivity low, affecting the farmer's income source. Farmers have reported that the rising costs of fertilizers and pesticides have added financial stress to their lives. These challenges are reducing crop productivity and negatively impacting the lives of farmers and their source of income. If all these things continue, it could seriously affect the food security and income in the area. There is a need for better solutions, like improved farming techniques and campaigns, to help the farmers.

Conclusion

The findings show that changes in rainfall patterns influence Wheat and Maize Production. Qualitative data from interviews revealed that farmers face many difficulties, such as less rainfall, insect attacks, pests, fungal infections, and crop diseases. The dry land and rising costs of seeds, fertilizers, and pesticides create many difficulties for farmers. These issues not only reduce the productivity of crops but also create financial stress for farmers. To ensure sustainable production of crops, farmers and policymakers must adapt climate-resilient strategies such as improved water management. By taking proactive measures, farmers can reduce the risks that are linked with climate change and ensure the security of food for future generation.

Recommendations

Based on these results, some recommendations exist to reduce the influence of changing rainfall patterns on Wheat and Maize Production. As there is less rainfall and the land is getting damaged, farmers in Mandra should be supported with better irrigation systems like tube wells, so the land does not dry up and crops get water when needed. Agricultural offices and the government should provide awareness to farmers through campaigns about Wheat and Maize varieties that do not get diseases in hot and dry conditions. The government should provide some discount on fertilizers and pesticides so farmers do not get financial stress. Accurate weather information can help farmers protect their crops.

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