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Climate Change Effect on Sugarcane and Rice Productivity: A Case Study in Gujrat

Abstract

This study examines how climate change interrupts the production of sugarcane and rice, especially in Gujrat, Punjab. Climate changes affect crop productivity, growth, and water availability, and farmer livelihoods. It has serious threats to crop growth. Climate change affects the availability of water management resources. The study focuses on the challenges that threaten the productivity of crops and traditional practices in Gujrat. It also focuses on sustainable farming techniques and advanced technology. This study emphasizes the consequences of climate change on two major crops, rice and sugarcane. This study highlights how climate change affects the productivity of crops like sugarcane and rice in the region of Gujrat and identifies the implementation to ensure the sustainable production of a particular region.

Keywords: Interrupt, Productivity, Growth, Challenges, Extreme Weather Events, Farmer Livelihoods, Consequences, Implementations & Sustainable Production

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Title

Climate Change Effect on Sugarcane and Rice Productivity: A Case Study in Gujrat

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Contents

Abstract

This study examines how climate change interrupts the production of sugarcane and rice, especially in Gujrat, Punjab. Climate changes affect crop productivity, growth, and water availability, and farmer livelihoods. It has serious threats to crop growth. Climate change affects the availability of water management resources. The study focuses on the challenges that threaten the productivity of crops and traditional practices in Gujrat. It also focuses on sustainable farming techniques and advanced technology. This study emphasizes the consequences of climate change on two major crops, rice and sugarcane. This study highlights how climate change affects the productivity of crops like sugarcane and rice in the region of Gujrat and identifies the implementation to ensure the sustainable production of a particular region.

Keywords:

Interrupt, Productivity, Growth, Challenges, Extreme Weather Events, Farmer Livelihoods, Consequences, Implementations & Sustainable Production

Introduction

Climate change is a serious problem facing the world today. Climate change is a major challenge for developing countries, especially in Pakistan. It affects crops, agricultural productivity, and water resources, and increases the risk of extreme weather events. Climate change may lead to water scarcity, which may reduce yield and lower the availability of food. Freshwater is important for agricultural production and increases the growth of crops. Due to an increase in the global population, the demand for food also increases. It may affect the quality and quantity of crops. The agriculture sector is important in Pakistan for providing food, employment, sustainable growth, livelihood, food security, and development to a large number of people. Sugarcane and rice are two of the major crops cultivated in the region of Gujrat. Both crops are important to achieve food for better health. These are not only important to serve as food, but these crops also have importance in generating income resources for many farmers. In Pakistan,

the rice crop is particularly sown between May and June, and sugarcane in the spring season between February and April. Both crops are harvested between October and November. Farmers sowing sugarcane in early March, but they hold back for a long period of time because the weather is getting hotter every year. Climate change is becoming a challenge to agricultural production. Insufficient crop production leads to economic instability, increased poverty rates, and hunger. Rising temperatures, heavy rainfall, floods, and droughts have seriously affected crop yields and agricultural wages (Ali et al., 2017; Khan et al., 2021). **Rice** needs about **2,500 to 3,000 liters** of water per kg of grain. At the same time, Sugarcane requires 1,500 to 2,000 mm of water during the whole growing season.

Climate change has prolonged effects on crops for the past few years, showing an intense increase in extreme weather events like ultraviolet rays, drought, and heavy rainfall patterns. It endangers and threatens the crops' growth and productivity in regions like Punjab, Pakistan. A decrease in yield also lowered the availability of food. Changes in rainfall patterns and extended dry periods have led to a considerable decrease in crop yields, including rice and sugarcane. It is especially in those areas where farmers are dependent on rainwater for the cultivation of crops. South Asia is vulnerable to climate-related risks such as intense waves, droughts, unequal rainfall patterns, and floods, which affect crop productivity and growth (IPCC, 2021). Climatic conditions are changing the exposure of rice in Punjab, Pakistan. It is particularly due to unequal rainfall patterns and increased temperature stress. (Rasul et al., 2012). Climate change leads to unpredictable rainfall patterns, which reduce water availability for agricultural land. Climate change is the major issue facing the world today that affects crops. Climate change presents a crucial threat to agricultural production in Gujrat, especially for crops like sugarcane and rice. Increasing temperatures, changing rainfall patterns, and increased frequency of severe weather events can impact crop productivity, water availability, and other resources. The agricultural sector is necessary to the local economy. Climate change can impact farmers' livelihoods. It may damage the production level, so farmers face difficulties in meeting their needs. They also lose their profit due to lower grain prices or a decrease in crop production. Farmers are obliged to get rid of their belongings. They get a loan to meet their needs. They lessen the expenses on health, food, gathering, education, and other basic needs. Climate change is an important universal issue that affects agricultural productivity and damages crops, especially for kharif crops like sugarcane and rice (IPCC, 2013). Due to a change in climate, the farmers need more water and fertilizers so that they can increase the production level and growth of crops. Disasters like floods and droughts have reduced growing cycles and affected economic conditions for farmers across South Asia. Increasing temperatures, changing rainfall patterns, and increased weather events like heat waves, floods, drought, and heavy precipitation can lead to reduced crop yields, changed growing periods, and boost disease pressure. Farmers faced critical growth due to changes in rainfall patterns or extreme heat waves. It may affect the growth stages of crops. Climate change can lead to serious yield losses, reduced crop weight, and grain quality (Malla et al., 2019). It may affect the farmer's basic necessities and livelihood.

Objectives

1. To examine the impact of climate change on sugarcane and rice productivity in Gujrat.
2. To determine the efficiency of different water resource management for sugarcane and rice production.
3. To investigate the policy that ensures the sustainable production and growth in the region of Gujrat.

Research Question

1. How do climatic factors impact sugarcane and rice productivity?
2. What water resource management practices are most effective for better production of sugarcane and rice?
3. What sustainable practices can farmers adopt to ensure the long-term productivity of crops?

Importance of the Study

Punjab is an important Agricultural Hub in Pakistan. It plays an important role in the local economy. It is known for the production of cotton. The significant crops are groundnuts, spices, wheat, bajra, mustard, maize, pulses, rice, and sugarcane. Sugarcane and rice are the most significant crops in

Gujrat, Pakistan. Many farmers rely on rainfall to grow these crops. They consume rainwater for the cultivation of these crops. Climate changes like unequal rainfall patterns, rising temperatures, or extreme weather events have effects on crops. It can damage crop yields, such as lowering the yield. It also affects the water resource management, which causes major problems for farmers. In such places where there are no proper water management systems, like tube wells, the farmers living in such areas suffer the most.

This study is also significant because it helps us understand how climate change, which is mostly changing rainfall patterns and increasing temperatures, is affecting the productivity of sugarcane and rice. This study is mainly focused on how climate change affects crops. By understanding these problems, we help the farmer and guide them on how to achieve better production. This study helps to identify the challenges and supports the farmers. This study introduces better techniques to ensure sustainable production.

Review of Literature

Rice is a high-water concentrated crop, and it consumes more water. It has a risk of water crises. Rice crops had effects due to delays in monsoons and high temperatures during the flowering stages. Similarly, sugarcane is a long-term crop and is affected by an unequal rainfall pattern. Sugarcane crops had instant pest attacks activated by warming conditions like high temperature (Wassmann et al., 2009; Ahmed & Schmitz, 2016). Climate change increases water stress and unpredictable weather events.

Raising temperatures can lead to increased crop water resources and reduced growth and productivity (Siddiqui et al., 2012). Changes in rainfall patterns can affect sugarcane production, growth, weight of yield, and development, leading to water scarcity and damage to crops (IPCC, 2013). Climate change can also increase the pest and pressure, further impacting sugarcane growth and productivity (Malla et al., 2019). During nighttime, when the temperature rises, it may affect the production of rice. It becomes lowering the grains. Special decrease in rice yield caused by an increase in temperature due to shortened growing cycle (Ali et al., 2021). Heavy rain and floods caused damage to rice yield as the time of harvesting is near. It may decrease the quality of grain (Wassmann et al., 2009)

Rice requires water for planting. The crop is semi-aquatic, and it needs a lot of water and regular rainfall for cultivation. When the rainfall pattern changes, sometimes it comes late or sometimes it is too heavy, the rice plantation is postponed or damaged. Increases in temperature during flowering can destroy rice growth and grain (Wassmann et al., 2009). Sugarcane grows over a long period of time. It may require smooth water. Due to an increase in temperatures and dry weather, such as drought, the crop of sugarcane is becoming lower and weaker. It has major effects on the growth of the crop. The crop also has less sugar, and it may increase the risk factor that pests are attacking it more (Ahmed & Schmitz, 2016).

Climate change can lessen rice yields, change the growing period, production, growth, and grain quantity (Malla et al., 2019). Changes in rainfall patterns can affect rice production, growth, and development, resulting in reduced yields (IRRI, 2015). An increase in temperature has a negative impact on crops, damaging the yield and reducing productivity. During the fertile stage of rice, increased temperatures lowered yield (Ali et al., 2017). In Punjab, the temperature has increased in the past few years. It may cause a change in the rainfall pattern. It has also become irregular. It comes at certain times, sometimes too late and sometimes too early. And other times it is not enough to cultivate crops. It may affect the water resources. If rainfall is too late, it is difficult to manage water resources. This is very difficult for farmers who depend on timely rain to grow rice and sugarcane. The farmers experienced difficulties in the cultivation of different crops (PMD, 2022).

Rice is highly susceptible to both heat and water stress (Wassmann et al., 2009). Due to climatic crises, there is a loss of yield in rice and sugarcane in Pakistan. It highlights the vital need for adaptation implementation and strategies such as improved irrigation systems and resilient crop varieties. Modern cultivating methods like minimal tillage and precision irrigation can help make farming more achievable and sustainable. These strategies and methods lowered the water wastage, minimized the fuel use, and protected soil health, which can lead to an increase in the production of crops (Srivastava, 2019). Sugarcane crops become

lower when there is too much extreme heat, and they also drop when there is not enough water (Khan et al., 2020).

Climate change not only affects the productivity and growth of crops, but it also has effects on the livelihoods of farmers and local people. Sugarcane and rice yields are highly susceptible to changing rainfall patterns (Hussain & Mudassar, 2020). During the early spring season, rising temperatures reduce sugar content and increase the chance of pests and diseases (Ahmed and Schmitz, 2016). Climate unpredictability, particularly in the form of increasing temperatures, changes in rainfall patterns, and continually extreme weather events, is important in lowering agricultural productivity (IPCC, 2022).

The agriculture sector of Punjab is facing serious climate-related challenges (PMD, 2022). Most efficient implementations, like drip irrigation and direct seeding, help restore water and improve crop quantity and quality under climate crises (IWMI, 2024).

Water resources are necessary for sugarcane and rice production, as both crops require large amounts of water for cultivation (Singh et al., 2018). Practices for the availability of water resources can be used in sugarcane and rice crops, including drip irrigation and direct seeding (Srivastava et al., 2019).Certified food security through climate-resilient agriculture (FAO 2020). Adaptation to new strategies and technologies that enhance land use is becoming common among farmers in response to reducing stress. These strategies can help lower water usage, enhance soil health, improve production, enhance crop growth, and improve crop yields (Singh et al., 2018). Sustainable practices and techniques make agriculture more efficient, achievable, and sustainable (Srivastava et al., 2019).

Materials and Methods:

Locale

This study will be conducted in the Gujrat region, which is located in the Punjab province of Pakistan. It is an ancient district between two famous rivers (the Jhelum and Chenab). This region is known for its fertile agricultural land. The region has high temperatures during the summer. Agriculture plays an important role in the local economy and livelihood, with crops including sugarcane, rice, maize, and wheat.

Data Collection

This research will use a semi-structured questionnaire to understand this topic deeply. It may include open-ended questions, and data will be collected through face-to-face interviews.

Methodology

The method used in this study is exploratory research because it is an easy way to gain a deeper understanding of qualitative data.

Methods

The in-depth interview method is used in this study because it will be an easy method to collect data from farmers.

Tool

A questionnaire, as a tool, is used in the study because it is an easy way of collecting data.

Data Analysis

An exploratory methodology will be used to understand the topic deeply.

Results and Analysis

The data of this study were gathered from 15 farmers in the district of Gujrat, Lala Musa. The respondents shared their experiences that climate change changes rainfall patterns and has become uneven, and increasing temperatures have led to decreased rainfall. As the temperature rises, crops need fertilizers and regular watering. The farmers are told that they are trying to manage their water resources more effectively to maintain crop productivity. Due to too much or too little rain, they lose their crop. They used a tube well to compensate for the lowering in rainfall patterns. In cases of heavy rainfall, they use technologies such as water pumps to remove extra water from the yields, which can help to reduce the risk of crop damage. Most of the farmers lacked awareness about the use of these technologies. Most of them used traditional methods, and a very few farmers used modern technology or had awareness about the advanced technology.

Due to climate change, farmers faced difficulties in increasing the production and growth of crops. They need more water and fertilizers so

that they can improve the production level. They also used machinery and advanced technologies. Furthermore, they consumed more fuel, which may increase the cost of yield. So these purpose farmers get a loan. It affects the livelihoods of farmers. The decrease in yield also decreases the income of the household. So the farmers reduced the income for food, health, and education. They faced problems in meeting their needs. It also increases the risk of malnutrition due to not enough food to eat.

For the past few years, farmers have faced significant difficulties in achieving good crop yields because of climate change. Climate change can cause a decrease, so it is difficult to grow enough food to sustain their livelihoods. It may increase health-related risk factors due to work in high temperatures and having insufficient resources to buy medicines.

It also increases the risk of diseases and pests. It can lead to grain loss. Most of the crops are affected by a change in climate. People think that the government should provide the training to farmers about technologies to improve the crops, and also introduce the strategies that may lead to better production.

Conclusion and Recommendations

This study explores the impact of climate change on the productivity, efficiency, and sustainability of crops. Most of the farmers used traditional practices to increase the production of crops. Climate change is making it difficult for farmers to grow crops productively. Sugarcane and rice, both crop productions, are endangered due to changes in rainfall patterns and high temperatures. Lowering in rainfall pattern causes a long dry period, which affects the sugarcane crop. And it affects the growth and production of crops, causing the plant to grow poorly and also produce less sugar.

Many farmers are experiencing lower crop yields, increased water management resources, and technologies. Farmers face a problem in getting the actual cost of yield. So that farmers faced difficulties in meeting their needs. It may also affect the local economy and the livelihoods of farmers.

These findings highlight the need for adaptive strategies and solutions to support farmers. The government should focus on water infrastructure development. Build small-scale dams to restore water. Modern techniques help save water, fuel, improve land health, increase crop production, **and** reduce environmental damage.

It may help them to overcome the challenges that they face due to the change in climate. It ensures precision agriculture. The study examines those sustainable agricultural practices, combined with government support and community-level action, that are necessary to ensure the long-term resilience of agriculture in the face of climate change.

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