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Investigating the Impacts of Continuous Flood on Agricultural Products in District Nasirabad, Balochistan (2010-2022)

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Abstract

The study titled investigating the impacts of continuous Flood on agricultural Products in District Nasirabad, Balochistan (2010-2022), intended to examine the long-term effects on agricultural products in District Nasirabad, which is one of the most fertile land, using a quantitative approach the study collected data from 400 respondents through structured questioners. The local farmers gave insights the crop variation degradation of soil and agricultural loss from 2010 to 2022 floods. The findings of the study shown the notable decline in agricultural production, mainly in Rice and Wheat. The damage of soil fertility, infrastructure, seed storage. The study also shown that farmers faced long-term financial instability and mostly depended on the government and unceremonious loans. In short, the findings study revealed that, constant flooding can causes serious destruction and danger to the agricultural activities in District Nasirabad. The study endorses that build channels for remove flood water to minimize the agricultural loss, also need to improve flood management system. Government should encourage to the investors to invest in the improvement of irrigation system.

Keywords: *Floods, agricultural production, Rice, Wheat, soil erosion*

Introduction

Nasirabad District in Balochistan, Pakistan, known for its agricultural activities, especially crops such as wheat, rice, and cotton. The District is also prone to flooding, which can disrupt farming and cause significant losses. Devastating natural disasters like flood that have far-reaching impacts on various sectors, including agriculture, infrastructure, and livelihoods. In regions comprehensively reliant on agriculture, such as Nasirabad District in Balochistan, the effects of floods can be devastating, causing to significant losses in crop production, livestock, and income. Pakistan experienced several severe floods between 2010 and 2022, increasing the vulnerability of agricultural communities in affected areas. Nasirabad District, located in the Balochistan Province of Pakistan, is primarily an agricultural region, agriculture is main source of the more the half of the population including livestock. Agriculture in the region is heavily dependent on seasonal rainfall and irrigation from local rivers and canals. However, floods often disrupt normal farming cycles, damaging crops, eroding soil, contaminating water sources, and displacing communities. Flooding in Balochistan, often as a result of monsoon rains, heavy rains, and poor drainage systems, has become an increasingly frequent phenomenon in recent years. According to the Pakistan Meteorological Department (PMD), Balochistan's barren landscapes and limited flood control infrastructure exacerbate the impact of such disasters on agriculture (PMD, 2012). During the period 2017-2022, floods increased in frequency and intensity in Nasirabad District escalated, resulting in widespread crops damage, soil erosion, the loss of livestock, and long-term disruptions to agricultural practices. These floods severely affected food security in the region, especially for farmers who depend on the land for their income and survival.

It includes the overall strategies and procedures used to collect reliable and accurate data, ensuring that the study objectives are effectively met. This study outlines the methodology adopted to investigate the impact of continuous flooding on agricultural production in Nasirabad District, Balochistan from 2010 to 2022. Given the recurrent and destructive nature of floods in the region, particularly their impact on agricultural activities such as wheat, rice, and livestock, this study employs a quantitative research design. This method allows for the collection of numerical data and statistical analysis to measure flood damage to agricultural production. Structured questionnaires and statistical tools are used to assess the impact on farming households, crop production, and infrastructure. The study area, sampling techniques, data collection tools, and ethical considerations are used to ensure that the research process is scientifically sound, comprehensive, and sensitive to local context. The district's vulnerability to flooding, coupled with its agricultural importance, makes it a key issue for understanding flood impacts and guiding future mitigation strategies.

Problem Statement

Between 2010 and 2022, Naseerabad Division (including Naseerabad and Jaffarabad districts), known as the agricultural green belt of the province, faced repeated devastating floods, often annually, which damaged standing wheat and rice crops, livestock, houses, infrastructure, and infrastructure. Above all, they cause waterlogging and soil degradation, which delays the planting season. These extreme events resulted in economic losses in the billions (e.g. Rs. 18 billion in 2012 alone), displaced almost the entire rural population, degraded the canal system, and destroyed food and water security by forcing farmers into debt, reducing productivity, and causing widespread food shortages and malnutrition, especially among children, in the region. The main reasons for this are linked to climate change – heavy rainfall, neglect of irrigation systems, changing monsoon patterns, and lack of alternative water channels for drainage.

Hypothesis

Hi: Flooding negatively affects wheat production by reducing crop yields, delaying growth, and causing soil degradation.

Hii: "Flooding affects rice production, sometimes increasing yields due to more water, but also reducing yields due to long submersion and nutrient loss."

Research Questions

1. What is the impacts of flooding on wheat production?
2. What is the impacts of flooding on rice production?
3. How does agricultural productions impact the social life?

Research Methodology

The research methodology provides a comprehensive framework for organizing, interpreting, and analyzing data to explore the impact of continuous flooding on agricultural production in Nasirabad District, Balochistan from 2010 to 2022. 12 year period. The study area includes the tehsils of Baba kot, Dera Murad Jamali, Nasirabad, and Tambo, which are known for their fertile land and major crops such as rice and wheat. A sample size of 400 respondents, selected uniformly from each tehsil using Yamane's formula, ensures a diverse and representative population. A stratified random sampling technique is used, in which participants are stratified by farm size, crop type, and flood impact level, followed by simple random sampling within each level. Data is collected through questionnaires focusing on population, flood impacts, and agricultural production. Responses was analyzed using SPSS software, applying descriptive statistics and frequency distributions. Ethical safeguards are prioritized throughout the research process, ensuring informed consent, confidentiality, cultural respect, and protection from harm.

Review of the Literature

Agricultural Products and Their Importance

Agriculture plays a critical role in shaping the global economy, society, and the environment. Agricultural products, ranging from cereals to vegetables, fruits, and livestock, serve as the fundamental source of food, raw materials, and energy. Over the centuries, agriculture has evolved, influencing the development of human civilization. As the global population continues to grow, agricultural products become increasingly vital not only for feeding the world but also for sustaining economic growth, ensuring environmental stability, and contributing to rural development. This literature review examines the significance of agricultural products, their contributions to global food security, economy, and sustainability, and highlights current challenges and opportunities in agricultural production. Agricultural products are the cornerstone of food security. According to the Food and Agriculture Organization (FAO), food security exists when "all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food" (FAO, 2020). Agricultural production is fundamental in achieving this, as it provides the necessary raw materials for food. Major agricultural products such as rice, wheat, maize, and pulses are staples for billions of people, especially in low-income countries, where the majority of the population relies on agriculture for food and income. In many developing nations, the agricultural sector constitutes a significant portion of the economy, both in terms of employment and gross domestic product (GDP). Agriculture remains the primary source of livelihood for over 40% of the world's population (Acheampong et al., 2024). For instance, in sub-Saharan Africa, agriculture employs over 60% of the working population and accounts for about 25% of the region’s GDP (World Bank, 2020). The increased production of staple crops is therefore critical for improving food security, reducing hunger, and addressing malnutrition. Cereals, such as rice, maize, and wheat, dominate agricultural production worldwide, accounting for approximately 70% of global caloric intake (Apel et al., 2022). These products form the basis of the human diet in both developed and developing nations. The diversification of agricultural products to include vegetables, fruits, nuts, and animal-based products provides essential micronutrients, fiber, and protein, which are necessary to address malnutrition, especially in children and vulnerable populations (Hallegatte et al., 2020). However, food security is increasingly threatened by climate change, population growth, and changing consumption patterns. As the global population continues to grow, demand for agricultural products will increase. Simultaneously, climate change poses a significant challenge to agriculture, affecting crop yields, pest and disease dynamics, and water availability (Haug, 2021). In this context, sustainable agricultural practices and innovations are essential to increase production while preserving the environment.

Agriculture and Floods

Every year millions of the people affect by the floods, flooding is one of the most disastrous tragedies in the world, causing fatalities, damaging the environment, livelihoods and damage of the infrastructure. There are the different types of the floods including flash flooding, river flooding, overflowing of the rivers. These floods have long-term effects on the agricultural as well as on the livelihoods, infrastructure. Mostly these floods caused by the climate change and melting of the snow which grow the huge flood to the agrarian lands. Pakistan has one of the world's most fertile lands and having well-established river system, originating from its North and merging to the South of the country. Pakistan irrigation system which was initially established by the British later on it was further developed during the 60s and 70s, which irrigating the millions of the fertile hectares in the country. The most catastrophes flood which is the major natural disaster to the state, Debris and trash buildup in floodwaters can make recovery even more difficult and raise the possibility of disease transmission According to (Jha & Gundimeda, 2019), river floods are often seasonal and result from a combination of factors such as the intensity of precipitation, the rate of snowmelt, and the condition of the catchment area. Research by (Jonkman & Vrijling, 2008) highlights the role of climate change in intensifying rainfall patterns, leading to more frequent and intense river floods. As temperatures rise, more water evaporates from the Earth's surface, which increases atmospheric moisture. When this moisture condenses, it falls as rain, often in heavy bursts that overwhelm rivers and streams. The increased frequency and intensity of extreme rainfall events, particularly in tropical and subtropical regions, are expected to exacerbate river flood risks in the coming decades (Lai et al., 2021). Coastal flooding is another significant cause of flood events, particularly in low-lying coastal regions. Coastal floods are often caused by storm surges, which occur when strong winds associated with tropical cyclones or hurricanes push large volumes of seawater onto land. In addition to storm surges, rising sea levels due to climate change contribute to the frequency and severity of coastal flooding (Mangora et al., 2023). A study by the Intergovernmental Panel on Climate Change (IPCC, 2021) warns that sea levels are expected to continue rising due to the thermal expansion of seawater and the melting of glaciers and ice sheets. This, coupled with more frequent extreme weather events, poses an increasing threat to coastal communities around the world. Rising sea levels reduce the ability of natural barriers, such as beaches and wetlands, to protect inland areas from flooding. Coastal cities such as New York, Miami, and Jakarta are particularly vulnerable to the impacts of coastal flooding. As populations in coastal cities continue to grow, the exposure of people and infrastructure to coastal flood risks is increasing, making it critical to assess and plan for these challenges (Ndungu et al., 2023). Flash floods are sudden and intense flood events that occur within a short period, usually within six hours of the rainfall event. Flash floods can be triggered by heavy rainfall, particularly in areas with steep topography, poor drainage systems, and impermeable surfaces. According to (Roy et al., 2020), flash floods are often associated

with thunderstorms or rapid snowmelt and are most common in urban and mountainous areas. Flash floods are characterized by their swift onset and short duration, making them particularly dangerous because they leave little time for warning or evacuation. The combination of heavy rainfall and steep slopes causes water to flow rapidly downhill, overwhelming small rivers and streams. In urban areas, the risk of flash flooding is further exacerbated by the presence of impervious surfaces such as roads and buildings, which prevent the absorption of rainwater and increase surface runoff. (Saha & Salam, 2023). The rapid onset and the severity of flash floods make them a serious challenge for flood prediction, response, and mitigation efforts. Urbanization is one of the primary drivers of increased flood risk, particularly in developing countries where cities are growing rapidly. Urban flooding occurs when rainfall exceeds the capacity of drainage systems to manage storm water runoff. Urban areas are particularly vulnerable to flooding due to the large proportion of impervious surfaces, such as roads, pavements, and buildings, which prevent water from infiltrating the soil (Shrestha et al., 2022a).

The increased volume of runoff in urban areas is compounded by the presence of inadequate drainage infrastructure. In many rapidly growing cities, drainage systems are outdated or unable to cope with the rising frequency of extreme weather events (Shrestha et al., 2022b). Urban flooding also leads to the contamination of water supplies, the destruction of infrastructure, and the displacement of residents. Studies have shown that cities in South Asia, sub-Saharan Africa, and Latin America are particularly susceptible to urban flooding due to high population densities and insufficient urban planning (Uddin & Sharma, 2024). Floods have profound impacts on human health, livelihoods, the economy, and the environment. The consequences of flooding can be immediate or long-term, and the severity of these impacts depends on factors such as the magnitude of the flood, the vulnerability of the affected population, and the ability of the region to recover. Floods pose significant risks to human health, both directly and indirectly. The immediate impacts of floods include drowning, injury, and the destruction of homes, leading to displacement. In addition to physical injuries, floods also cause mental health challenges, including anxiety, depression, and post-traumatic stress disorder (PTSD). Studies by (Yu et al., 2023) found that people living in flood-prone areas often experience long-term psychological stress due to the threat of future flooding and the loss of homes and belongings. Floodwaters can also spread waterborne diseases, such as cholera, typhoid, and dysentery, especially in regions where sanitation systems are overwhelmed or damaged. According to (Haug, 2021), floods increase the risk of contamination of drinking water supplies, which can lead to outbreaks of infectious diseases. The disruption of healthcare services during and after floods further complicates the provision of medical care, particularly in remote or underserved areas. The economic consequences of flooding are vast and multifaceted. According to (Haug, 2021), flooding causes an estimated $115 billion in global economic losses each year, with this figure expected to rise in the coming decades due to increased exposure to flood risks and

climate change. Direct economic losses include damage to infrastructure, buildings, agricultural crops, and industrial facilities. Indirect costs, such as lost productivity, recovery expenses, and health-related costs, are also significant. Agricultural production is often heavily impacted by flooding, particularly in regions where the economy is dependent on crop cultivation. Floods can destroy fields, wash away soil, and disrupt supply chains, leading to food insecurity and economic hardship for local farmers (Lai et al., 2021). The recovery of economic activity can take months or even years, depending on the severity of the flood event. In urban areas, the damage to buildings, roads, and utilities can have far-reaching economic effects. Businesses may be forced to close, and the rebuilding process can be expensive and time-consuming. In coastal areas, the combination of rising sea levels and extreme weather events poses an even greater threat to economic stability, particularly in tourism-dependent regions. Flooding has significant environmental consequences, particularly in ecosystems that are already vulnerable due to human activities. Floodwaters can inundate wetlands, forests, and agricultural lands, leading to soil erosion, loss of biodiversity, and changes in water quality. Research by (Saha & Salam, 2023) suggests that floods can disrupt the natural balance of ecosystems, causing long-term damage to plant and animal populations.

One of the most frequent and widespread natural disasters, floods have a major impact on ecosystems, economies, and human populations. In contrast to sudden, temporary flooding events, they describe persistent or prolonged flooding events that last for a long period of time, sometimes days, weeks, or months. Due to urbanization, changes in land structure, and climate change, such floods are becoming more frequent and severe in many regions of the world and are affecting lives. (Jha et al., 2018). Given the devastating impacts of flooding, effective flood risk management is essential to reduce vulnerability and enhance resilience. Flood risk management strategies are typically divided into structural measures, non-structural measures, and preparedness and response strategies.

Key Findings

S. No.	Theme	Key Finding	% Respondents
1.	Flood Impact on Agriculture	Reported significant impact of 2010 flood on agriculture	70%
		Believe floods increased in frequency	75%
		Experienced crop damage due to floods	70.5%

S. No.	Theme	Key Finding	% Respondents
		Financial losses in agriculture business	66.1%
2.	Government Response	Received government aid or compensation	17.3%
		Did not receive any aid	81.7%
3.	Adaptation in Agriculture	Considering reducing agricultural activities	59.4%
4.	Employment & Land Impact	Experienced farmland flooding (2010–2020)	100%
		Agree floods affected agriculture-related employment	Majority
5.	Crop-Specific Impacts	Wheat production not significantly affected	89.1%
		Soil quality in rice fields negatively affected	66.3%
		Delayed rice planting due to floods	82.8%
		Harvesting rice affected	76.2%
		Rice quality not impacted by water contamination	69.1%
6.	Post-Harvest & Irrigation	Difficulty in crop storage	63.1%
		No alternative irrigation methods	66.3%
7.	Soil & Infrastructure	Decreased soil fertility	70.3%
		Lack of flood management infrastructure	75%
8.	Food Security	Reduced food availability during floods	77.7%
		Agricultural losses led to increased food prices	73%

S. No.	Theme	Key Finding	% Respondents
9	Displacement and Migration	Temporarily migrated	75.5%
		Reported village displacement	65.1%
10.	Education Disruption	Children's education disrupted	66.6%
11.	Household Economy & Health	Income declined due to floods	69.6%
		Increased health problems	71.5%
		Water contamination from floods	70.3%
		Mental health issues due to economic stress	58.4%
12.	Social Impacts	No major increase in resource conflict	69.6% (No)
		Financial instability for farmers	71.3%
13.	Policy and Support	Government policies need improvement	82.2%
		Received flood-related financial aid	17.3%
		Benefited from recovery programs	26.5%
14.	Transportation and Logistics	Faced difficulty in product transport	73.5%
15.	Community Response	Willing to support community flood prevention	77%
16.	Crop Health	Increase in plant diseases	54.7%
17.	Adaptive Capacity	Interest in training for flood-resilient farming	81.4%
		Unaware of modern flood-resistant farming	70.8%
		Not using flood-resistant varieties	78.5%

S. No.	Theme	Key Finding	% Respondents
18.	Infrastructure Needs	Inadequate drainage systems	72%
19.	Coping Strategies	Sold livestock/assets	37.1%
		Borrowed loans	19.8%
20.	Severe Economic Loss	Lost over 75% of income due to floods	33.4%
21.	Climate Change Awareness	Believe climate change has very high impact on productivity	37.1%
		Believe it has a high impact	22.3%
22.	Crop-Specific Loss	Rice most affected, followed by fruits, wheat, vegetables, cotton	37.1% (Rice)
23.	Seasonal Patterns	Floods occur mostly in monsoon season	51%
		Also occur significantly in summer	33.4%
24.	Wheat Yield	Minor wheat yield loss (0–10%)	89.1%
25.	Rice Yield	26–50% rice yield loss	32.2%
		Over 75% rice yield loss	13.1%
26.	Market Impact	Floods affected prices and access to markets	50.8% / 50.7%
27	Planning & Mitigation	Better planning can reduce losses	58.1%

Discussion

This study provides a comprehensive assessment of the devastating impacts of recurrent floods in Nasirabad district from 2010 to 2022, highlighting the profound agricultural, economic, social, and infrastructural challenges facing the region. The findings emphasize that small-scale farmers, who form the backbone of the local economy, have been the hardest hit, facing repeated crop losses, especially rice and wheat, coupled with the deterioration of irrigation

systems, declining soil quality, and reduced access to markets and resources. The complex impacts of climate change, outdated agricultural practices and weak institutional responses have deepened the crisis, leading to increased poverty, food insecurity and rural-urban migration. One of the most striking observations is the lack of sufficient government intervention and long-term planning, with limited financial assistance, inadequate flood control infrastructure, and low awareness of flood-resistant agricultural techniques among farmers. Despite the community's willingness to adopt better practices, there is a clear gap between knowledge transfer and technical assistance. Additionally, studies draw attention to the psychological and social toll of flooding, including mental health challenges, displacement, and disruption to education. This research also points to a critical need for coordinated and data-driven policy responses. These should include investments in flood-resistant infrastructure, improved drainage systems, early warning systems, and farmer education programs tailored to local conditions. Strengthening institutional capacity and coordination among stakeholders is essential to implement effective flood management and climate adaptation strategies. Overall, this study provides valuable insights for policymakers, development agencies, and researchers, presenting a clear picture of vulnerabilities and potential solutions. This requires urgent, coordinated, and sustained action to enhance the resilience of agriculture in Nasirabad and other flood-prone areas of Pakistan, which is critical to ensuring long-term food security, economic stability, and rural development in the country.

Conclusion

The study concluded that recurrent floods in Nasirabad district from 2010 to 2022 had severe and long-lasting impacts on agricultural production, rural livelihoods, infrastructure, and the socio-economic structure of the region. Small-scale farmers, who form the backbone of the local economy, have been disproportionately affected, facing widespread crop and livestock losses, soil degradation, irrigation disruptions, and reduced income. Despite the central role of agriculture in Pakistan's economy, the response to flood-related challenges is inadequate, with limited institutional support, poor flood management infrastructure, and minimal access to financial assistance or relief programs. These findings highlight clear gaps in awareness and flood-resistant farming techniques, as well as inadequate drainage and disaster preparedness systems. Furthermore, respondents have recognized climate change as a major factor contributing to the impacts of large-scale flooding and agricultural losses, particularly deteriorating rice and wheat production. This study emphasizes the urgent need for comprehensive, data-based, and sustainable strategies for improved flood management, infrastructure development, farmer training, and resilience building, ensuring food security, and supporting the livelihoods of vulnerable agricultural communities such as flood-prone areas.

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