

PERCEPTIONS AND ADAPTATION: FARMERS' RESPONSES TO CLIMATE CHANGE: A CASE OF PAKISTAN

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Abstract

This study examines how farmers in Pakistan's District Layyah view and react to the increasing effects of climate change on agricultural output. The study employs a qualitative research methodology, gathering valuable insights through field observations, focus groups, interviews, and oral narratives. Farmers frequently noted observable changes in the local climate, such as erratic rainfall, increasing temperatures, protracted droughts, and frequent floods. Traditional agricultural methods, such as planting and harvesting timetables, have been upset by these environmental changes, which have resulted in decreased crop output, an increase in pest infestations, and a rise in animal and crop diseases. Farmers showed a profound understanding of these difficulties, based on both firsthand experience and customary wisdom. Many have started implementing adaptive tactics, such as switching up crop varieties, modifying when to plant, and modifying how to care for livestock. The study also shows that socioeconomic characteristics, including age, education, and information availability, have a significant impact on how well farmers are able to adapt to climate shocks. Despite being frequently left out of official decision-making processes, women are essential to livestock management and bear a greater burden as a result of shifting climate conditions. The results demonstrate how urgently policy interventions that encourage gender-inclusive practices, boost climate-resilient agriculture, and increase farmers' access to climate tools and information are needed. Maintaining livelihoods and building resilience in the face of climate unpredictability require arming rural communities with information, resources, and institutional support.

INTRODUCTION

Global temperatures have risen by 0.74°C in the past century, and by 2100, they may have risen by 1.8 to 4°C, according to the McCarthy (2011). Extreme weather events including droughts, floods, and cyclonic storms are predicted to occur more frequently and with greater intensity as a result of these changes. Natural disasters, soil erosion, and waterlogging already pose a danger to Pakistani agricultural livelihoods, lowering farm production and landholding sizes (Mahendra Dev, 2012). Rural

communities' possibilities for a living are further restricted by the growing stress of the climate. Rainfall and glacier-fed irrigation, especially from the Himalayas, Karakoram, and Hindu Kush ranges—which have the fourth-largest ice deposits in the world—are essential components of Pakistan's agricultural system (Rasul et al., 2008).

Climate change is changing environmental conditions throughout Asia, changing seasonal rainfall patterns and warming cooler regions. Prolonged dry periods

result in drought, whereas more rainfall during rainy seasons causes flooding. Economic growth and agricultural productivity are directly threatened by these developments (Vitousek, 1992). Affected sectors include infrastructure, fisheries, ecosystems, human health, and water resources. Because they rely only on agriculture and a stable climate, impoverished communities are particularly vulnerable.

There are three primary ways that climate change impacts crops: it changes temperature and rainfall patterns, which affect soil moisture and crop growth; it raises temperatures above what many crops can tolerate; and, although some crops may benefit from higher CO₂ levels, overall yield is frequently negatively impacted. In Sri Lanka, for example, a small increase in temperature decreased rice yield by 6%, and dryness affected the production of tea, coconuts, and rubber. Similarly, while rice is thought to be less sensitive, temperature increases in Pakistan have had a severe impact on the harvests of wheat, cotton, sugarcane, and mango. (Premalal et al, 2009; Houghton et al., 2001; Gitay, H., & Brown, 2001).

Soil erosion, landslides, and extreme weather shifts are being brought on by the increasing frequency of climate-related events including drought and rainfall variability. One of the most significant issues of the twenty-first century is climate change, which poses a major risk to community stability and food security (Nguyen et al, 2017). Nonetheless, a growing number of farmers are learning about these hazards and becoming ready to deal with the growing unpredictability associated with climate change. (ADB, 2009; Change; Lobell et al., 2011).

In Pakistan, climate change has become a major danger to agriculture, especially for rural populations whose livelihoods rely largely on livestock and grain production. Soil erosion, deforestation, and land degradation have been caused by rising temperatures, erratic rainfall, and an increase in the frequency of natural disasters like droughts and flash floods (Syed et al, 2022). Along with harming crops, these changes also make it easier for pests and diseases to proliferate, which lowers agricultural output and exacerbates food insecurity. Due to their primary reliance on agriculture for livelihood, rural communities—particularly those in District Layyah—are extremely vulnerable. (GoP, 2008; Chandio et al., 2016).

Human activities that strain natural resources, like population increase and rural-to-urban migration, are contributing to climate change in Pakistan. Rising temperatures and shifting rainfall patterns have a significant impact on agriculture and livestock, two industries essential to food security and rural communities. Climate-related issues including water scarcity and disease outbreaks endanger the production of livestock products, such as milk and meat, which are vital components of the daily diet (World Bank, 2009). The Pakistani government has suggested a number of actions to shield the livestock and agricultural industries from the damaging effects of climate change. Climate change is still a major concern in South Asia, where more than 75% of the population relies on rain-fed agriculture and cattle (Government of Pakistan, 2018).

One of Pakistan's main crops, rice, is especially vulnerable to temperature fluctuations. When temperatures rise above the ideal range, Punjab, which makes up 90% of the rice-growing region, faces serious concerns. Crop yields are impacted, but export earnings and national food security are also at risk (Ali et al, 2017). Due to shifting climatic circumstances, Pakistan's agriculture industry has seen both economic successes and disappointments over the last 50 years. Climate change has caused rice crop losses to reach as high as 20% in recent years, which is almost twice as much as what has been seen in wheat production (Siddiqui et al., 2012; Iqbal et al., 2009). Addressing climate change is critical for sustainable development because of the agriculture sector's pivotal position in the national economy (Rahman et al, 2015).

Pakistan's agriculture, which provides a living for almost 70% of the workforce, is seriously threatened by climate change. Poor farmers are finding it difficult to deal with the consequences of climate change, such as unpredictable rainfall, extreme weather events, and rising temperatures, particularly in rural areas (FAO, 2011). These issues worsen rural poverty and jeopardize food security. Climate-related problems impact over 600 million rural residents, many of whom depend on livestock as a source of income. Water scarcity and the rise of animal diseases are stressing hunting, rain-fed crops, and livestock production (Thornton, 2010).

Climate change has a significant impact on Pakistan's two primary farming seasons, Rabi and Kharif. Kharif crops, such as rice and sugarcane, grow from May to October, whereas Rabi crops, such as wheat and mustard, are grown from November to April. These cycles are being upset, though, by shifting rainfall patterns and warming temperatures (Ali et al, 2017). The majority of Layyah's farmers are elderly, have no formal education, and use age-old farming methods that have been handed down through the generations. Village youth are shifting more and more towards non-agricultural occupations, leaving the rural community less prepared to deal with climate change. (Shahzad & Amjad, 2022).

The severe effects of climate change on rural Pakistan are best illustrated by extreme weather events like the floods in 2010 and 2011. These floods damaged 1.85 million homes, ruined more than 3.4 million hectares of agricultural land, and killed 1,764 people. Layyah and other districts experienced significant losses in infrastructure, society, and the economy. Public health and food security are also at risk from water-related problems, glacier melting, and the emergence of climate-sensitive illnesses like dengue and malaria (Husain & Rao (2014). Global warming is being accelerated by the buildup of greenhouse gases such as CO₂, CH₄, and NO₂, hence it is critical to comprehend and address farmers' perspectives and experiences in places like Layyah. Mustafa (2011).

Scope of the Study

The views, experiences, and adaptive responses of farmers in District Layyah, Pakistan, to the effects of climate change on agriculture and livestock are the main topics of this study. It seeks to comprehend how local farming populations perceive environmental changes, including droughts, floods, temperature swings, and erratic rainfall, and how

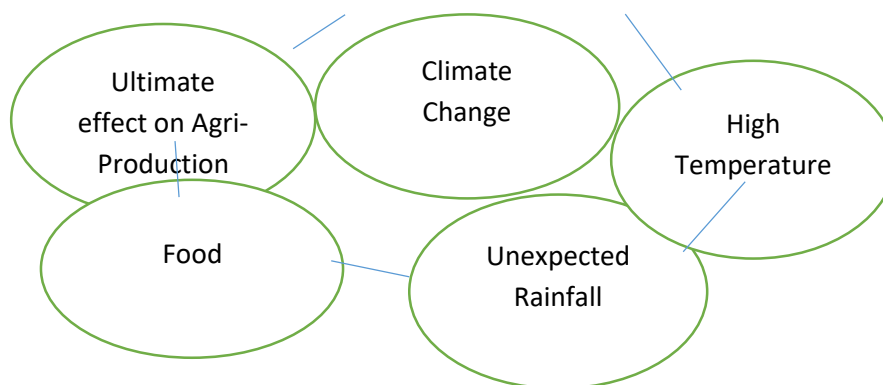
these changes impact rural livelihoods and agricultural output. In addition, the study looks at how socioeconomic factors, gender dynamics, education, and traditional knowledge influence farmers' awareness and adaptive tactics. The study offers context-specific insights into the resilience and vulnerabilities of rural communities through the use of a qualitative methodology. At the local and national levels, the results are meant to guide climate-resilient agricultural planning, support services, and policymaking.

Significance of the Study

This study is important because it sheds light on how farmers in District Layyah, Pakistan, perceive and experience climate change at the local level. The research showcases the practical effects of environmental changes on rural lifestyles and agricultural output by documenting their adaption tactics, traditional knowledge, and lived experiences. It highlights how important local practices, gender dynamics, and farmer awareness are in determining climate resilience. Policymakers, development organizations, and agricultural institutions can use the study's insightful recommendations to create focused, inclusive, and context-sensitive interventions that strengthen farming communities' ability to adapt and advance sustainable agriculture in the face of growing climate challenges.

Objective of the Study

This study's primary goal is to investigate and evaluate farmers' perspectives, experiences, and adaptive reactions to the effects of climate change on agriculture and livestock in District Layyah, Pakistan, in order to offer context-specific knowledge that can guide the development of climate-resilient agricultural policies and practices.



Climate change's cyclical effects on agricultural output are depicted in the diagram. Rising temperatures brought on by climate change interfere with regular weather patterns and increase the likelihood of unforeseen rains. These erratic downpours frequently cause flooding, harming farmlands and crops (Nelson et al, 2014; Aydinalp & Cresser, 2008). The result of the combined effects of floods and hot temperatures is a decrease in agricultural productivity. This cycle highlights how, particularly in sensitive areas like Pakistan, climate change both directly and indirectly threatens the sustainability and stability of agricultural systems.

Theoretical Framework

The structure that can hold or support a research study's theory is known as the theoretical framework. The theory that explains the existence of the research problem is introduced and described in the theoretical framework. The Ricardian idea of "global warming" serves as the foundation for the current study's theoretical framework. He asserted that the high temperature is caused by greenhouse gases such as carbon dioxide emissions. Furthermore, a number of issues, like global warming and unexpected rains, are being brought on by the world's temperature rising so quickly (Darwin, 1999). He also asserted that one of the primary causes of high temperatures is carbon dioxide. Ricardo examined the effects of climate change on agricultural productivity using a traditional estimation technique, which is based on analysis utilizing the production function.

The relationship between agricultural output and climate change was the primary emphasis of Ricardian theory. According to this argument, climate change contributes to global warming, which in turn lowers agricultural productivity (Mendelsohn, 2009; Reinsborough, 2003). My research, which focused on the region of Layyah and was based on the Ricardian framework, looked at how climate change is affecting agricultural output. My study's results aligned with the Ricardian findings as well. My research also showed that rising temperatures brought on by climate change lead to higher agricultural output. In the end, it lowers agricultural crop yield.

Research Methodology

Qualitative Research Approach

A qualitative research methodology was used in this study to investigate how climate change is affecting agricultural output in District Layyah. Gaining a thorough grasp of farmers' perspectives, experiences, and coping mechanisms in reaction to environmental changes was the main goal of the approach. Semi-structured interviews, oral narratives, and focus groups with local farmers—especially household heads, who are crucial to agricultural decision-making—were used to gather primary data. Through these techniques, participants were able to exchange firsthand knowledge, lived experiences, and local observations regarding crop failures, livestock problems, changing weather patterns, and other climate-related issues.

Data Collection and Contextual Insights

Three union councils representing both highland and lowland regions—Kot Sultan, Bukhri Ahmad Khan,

and Bait Wasawa Shomale—were chosen as responders using a purposive sample technique. Transect walks and field observations offered more background to support the qualitative results. Additionally, secondary data from academic literature, government records, and local NGOs helped define the study's socioenvironmental context. The community's awareness, traditional knowledge, and limitations in adjusting to environmental stressors were highlighted by the qualitative technique, which offered deep, contextual insights into how farming practices and rural livelihoods are impacted by climate change.

Results and Discussion (Qualitative Method Approach)

The results of a qualitative data collecting study examining farmers' perspectives and actual experiences with climate change and its effects on agriculture in District Layyah are presented in this chapter. Several important themes surfaced from different union councils who participated in focus groups, in-depth interviews, and participatory observation. Farmers continuously reported observable environmental changes, including temperature swings, erratic precipitation, extended droughts, and increased floods. Many reported increased seasonal cycle uncertainty, decreased crop productivity, and changed planting and harvesting dates.

These stories, which are frequently connected to traditional knowledge systems, demonstrate a profound local understanding of climatic disturbances. The qualitative information highlights how farmers actively perceive environmental change and modify their methods in response to personal experiences. The results are consistent with previous research (Huong et al, 2019), but they also provide context by highlighting the practical and emotional aspects of how climate change is being felt locally.

The socioeconomic elements impacting farmers' capacity to adapt to climate change were also discussed in detail. The majority of responders came from big, blended families where farming is the main source of income (Below et al, 2012). Their

knowledge of and ability to adjust to shifting environmental conditions were greatly influenced by their educational background. More formally

educated people were more likely to be concerned about long-term environmental effects and showed a stronger understanding of climate-smart farming techniques. Similarly, younger farmers knew more about coping mechanisms, whereas older farmers relied more on instinct and traditional knowledge (Tangonyire & Akuriba, 2021). The qualitative data showed a common concern about the increasing weather unpredictability and the decreasing stability of agricultural products, which have a direct impact on the sustainability of livelihoods (Uddin et al, 2014).

Lastly, qualitative reports demonstrated how farmers have observed direct effects of climate change on agricultural yields and planting schedules (Laux et al, 2010). Numerous people noted either short-term or long-term changes in the sowing seasons, and more than of them acknowledged that climate variability had changed the length of the sowing season (Zimmermann et al, 2017). Respondents reported lower yields, postponed planting, and crop failures brought on by severe weather. While some experienced more frequent disruptions, others characterized these shifts as "occasional." A similar thread surfaced despite differing opinions: climate change is no longer a remote threat but rather a pressing reality (Mall et al, 2017). These results highlight how crucial it is to incorporate farmer perspectives and knowledge into future agricultural planning and climate adaption programs.

According to the qualitative findings, farmers have closely observed a variety of climate change consequences on the production of crops and cattle. Significant temperature rises, bug outbreaks, and crop disease occurrences were reported by respondents. Many voiced worries about soil erosion, pest invasions, shorter growing seasons, and changing rainfall patterns, all of which are viewed as risks to the sustainability of agriculture. Reduced crop yields, water shortages, and growing farming costs were also acknowledged by farmers as factors that impact household livelihoods. These firsthand observations are consistent with previous studies (Vedwan, N., & Rhoades, 2001; Parry, 2019), which similarly emphasized the hazards that climate change poses to crop yield and health.

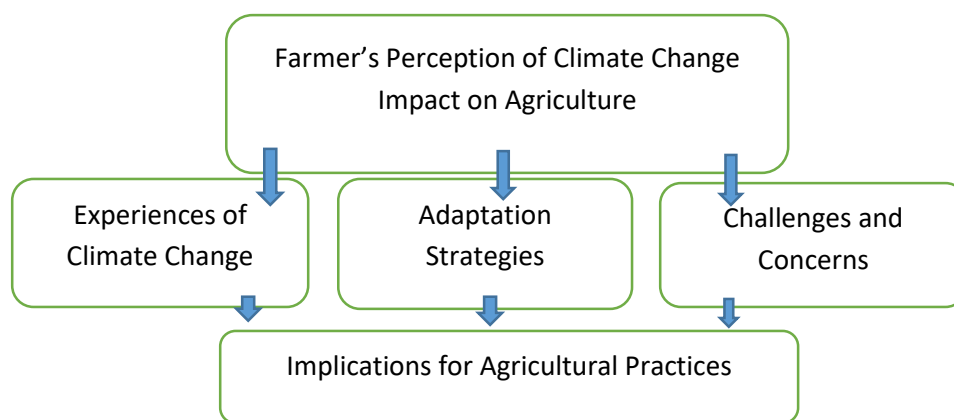
Farmers saw a decline in milk quality, protein content, and general animal health as a result of climate change

(McMichael, et al, 2007). Frequent causes of livestock mortality were identified as heatwaves, dwindling water sources, and disease outbreaks as Rind Pest and Rift Valley Fever. A sizable percentage of respondents reported severe stress on the health and productivity of their cattle, even though some did not witness these consequences firsthand (Babinszky et al, 2011). Additionally, producers showed agency by implementing climate risk mitigation adaptive measures including changing pesticide use and sowing seasons. These accounts offer deep, situation-specific insights into how rural farming communities perceive and react to environmental shifts that impact their means of subsistence (Gauly et al, 2013).

Perceptions of Climate Change and Environmental Shifts

Farmers in Pakistan are becoming more conscious of how the shifting climate affects agriculture. A rise in average temperatures, changes in rainfall patterns, and an increase in extreme weather events like heatwaves, droughts, and floods have all been noted by the majority of farmers (Hartter et al, 2012). Schedules for planting and harvesting have been thrown off, crop yields have decreased, and pest and disease outbreaks have increased as a result of these

environmental changes (Pyhälä et al, 2016). Additionally, farmers believe that soil fertility and water availability are declining, which has compelled them to modify their conventional farming methods. Despite their lack of formal education on the scientific mechanisms underlying climate change, many people directly link these changes to it. Additionally, farmers' perceptions of climate change are frequently shaped by their own experiences as well as generation-old local knowledge. Due to their restricted access to climate-resilient infrastructure and contemporary agricultural technologies, smallholder farmers in particular feel more vulnerable. They worry about the long-term viability of their means of subsistence, particularly in light of the ongoing threat to food security posed by unpredictable weather (Metz et al, 2009). Many farmers have started implementing adaptation strategies like switching crop varieties, modifying irrigation techniques, and diversifying their revenue streams in spite of scarce resources (Funatsu et al, 2019). This demonstrates the pressing need for focused government policies, education initiatives, and support networks to increase their ability to handle issues brought on by climate change.



Farmer's Perceptions of Climate Change Impacts on Agriculture in Pakistan

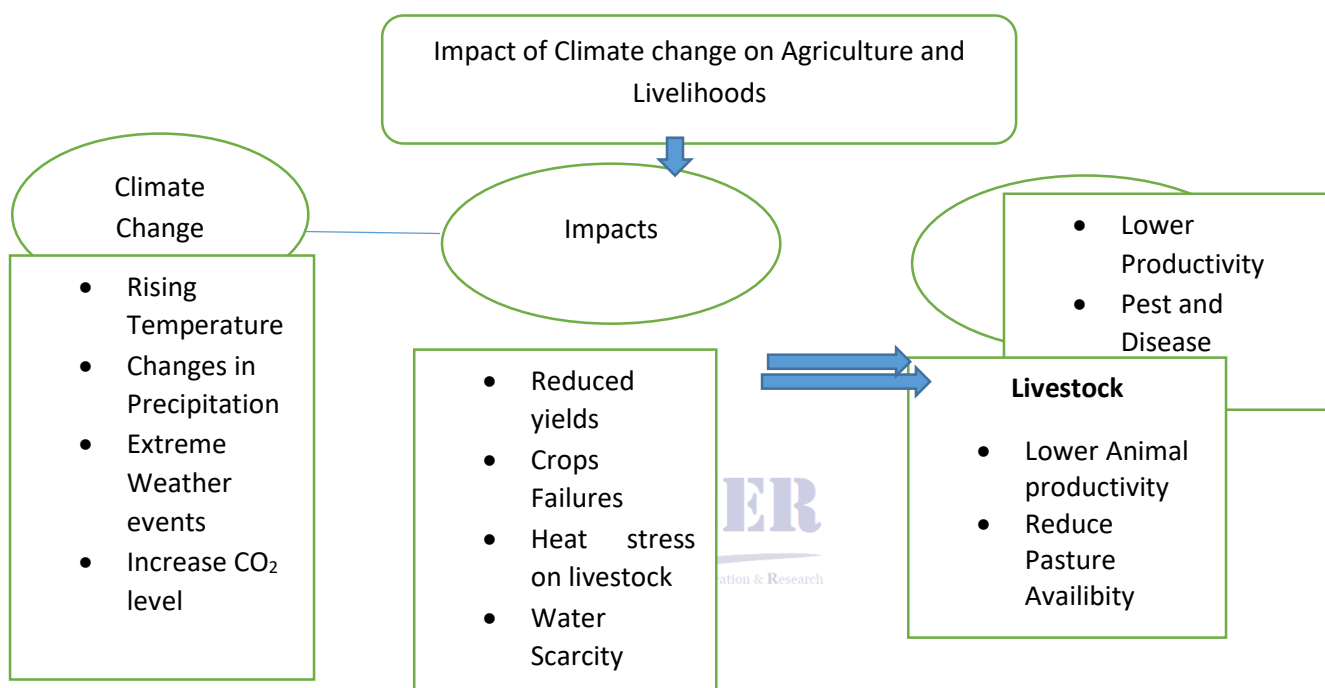
Pakistani farmers have noted observable climatic shifts in recent years, such as erratic rainfall patterns, rising temperatures, and an increase in the frequency of catastrophic weather occurrences. Reduced crop yields, degraded soil, and water scarcity are the main

ways that these changes have negatively affected agricultural output (Abid et al, 2019). Numerous farmers stated that their customary planting and harvesting timetables had been upset by changing weather patterns, which has resulted in uncertainty

and decreased yield. Additionally, they see an increase in agricultural illnesses and pest infestations connected to shifting environmental conditions, which puts their livelihoods at even greater risk.

Farmers' perspectives also emphasize how susceptible livestock output is to climate stresses like heat waves and dwindling feed supplies. Heat stress increases the risk of disease in addition to having an impact on animal productivity and health. In spite of these

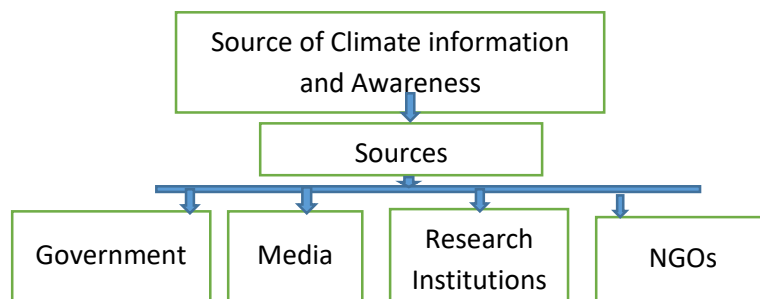
obstacles, a lot of farmers have come up with flexible tactics including changing crop types, modifying when to plant, and broadening their revenue streams (Fahad & Wang, 2018). In order to create successful climate adaptation policies that complement farmers' experiences and expertise and, ultimately, ensure sustainable agriculture and food security in Pakistan, it is imperative to comprehend these viewpoints (Muneer et al, 2024).



Sources of Climate Information and Awareness

Farmers in Pakistan obtain climate-related information from a variety of sources, which greatly influences how they view climate change and how it affects agriculture. Local radio and television broadcasts, agricultural extension services, conversations with other farmers, and, more and more, weather updates via mobile phones are the most popular sources (Chukwuji et al, 2019). However, there is frequently restricted access to

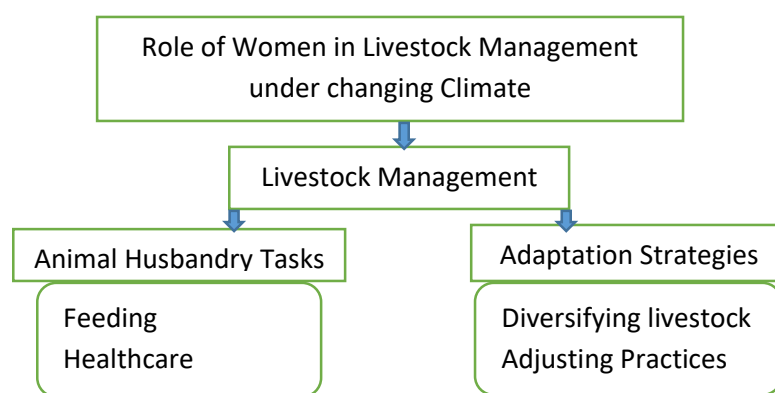
timely and reliable information, particularly in rural areas with low technical infrastructure and literacy rates. Farmers' capacity to plan crops, schedule irrigation, and implement adaptation measures is hampered by this lack of constant awareness (Umar, 2016). Designing efficient communication routes and boosting resilience against climate-induced agricultural difficulties require an understanding of where and how farmers obtain climate information.



Role of Women in Livestock Management under Changing Climate

Climate change is making it more difficult for women to handle cattle in rural Pakistan, where they play an important but frequently overlooked role (Hertkorn et al, 2015). Women are the primary carers for animals, handling minor health issues, cleaning shelters, feeding, and milking. Farmers admit that women have a profound awareness of how rising temperatures, water scarcity, and fodder shortages affect animal behaviour, health, and output because of their daily interactions with cattle (Bhanotra et al, 2015).

Climate change, however, has increased the workload for women by making their duties more physically and time-intensive. Reduced pasture availability, decreased milk output, and heat stress on livestock have all become commonplace, according to farmers (Awumbila & Momsen, 1995). Despite playing a crucial role, women frequently do not have access to veterinary care, training, or understanding about climate resilience (Adhikari, 2021). The sustainability of rural livelihoods in the face of changing climate circumstances depends on increasing women's participation in livestock-related decision-making and strengthening their ability to adapt.



Discussion

The results of this study unequivocally demonstrate that agriculture and cattle in Layyah, Pakistan, have been significantly impacted by climate change. Increased heat, erratic rainfall, droughts, floods, and pest outbreaks have all been reported by farmers as having significantly impacted crop cycles and livestock

productivity (Fahad & Wang, 2020). Traditional agricultural methods have become unstable due to these shifting weather patterns, which have also decreased crop yields, particularly for wheat and rice, which are extremely sensitive to temperature changes (Ali et al, 2020). The work supports earlier studies showing that the frequency and intensity of climate-related hydro-meteorological events are rising,

posing a direct danger to national food security and rural livelihoods.

The study also shows that the majority of farmers are conscious of the environmental changes taking place in their immediate surroundings. Many respondents stated that they use media like newspapers, radio, and television to learn about the weather and track variations in temperature and precipitation (Syed et al, 2022). Although people are generally aware of climate change, they don't fully understand long-term mitigation and adaptation strategies (Usman et al, 2025). This disparity indicates that in order to provide farmers with useful skills and methods for climate-resilient agriculture, more easily accessible climate education and community-based training are required. To promote adaptation, actionable knowledge is necessary; awareness alone is insufficient.

Conclusion

The study unequivocally shows that Pakistan's Layyah district's agriculture and livestock are significantly and intricately impacted by climate change. The majority of respondents mentioned noticeable variations in temperature, precipitation patterns, and planting seasons, all of which have had a direct impact on decreased agricultural yields, pest incursions, degraded soil, and a rise in crop and animal illness (Bernabucci, 2019). The unpredictable timing and intensity of rainfall has caused floods, droughts, and other extreme weather events that interfere with the growth cycles of important crops including wheat, rice, cotton, and maize, according to farmers (Rust, 2019). According to the findings, farmers are becoming more conscious of these environmental changes, and many are implementing adaptive measures including modifying pesticide usage, utilizing heat control sheets, altering sowing seasons, and even thinking about greenhouse farming.

When it comes to livestock, climate-related issues including heat waves, water shortages, and disease outbreaks have drastically decreased milk quality and production, hampered reproduction, and raised mortality (Escarcha et al, 2018). The study also demonstrates that despite the fact that most farmers have little to no formal education, they have extensive firsthand understanding of how environmental changes impact their means of subsistence (Thornton et al, 2009). Their answers point to the necessity of

The role that women play in managing livestock is a significant gender-related component of the study (Hertkorn et al, 2015). Animal feeding, milking, shed cleaning, and fodder collection are all done by women. Under climatic stress, these duties have become increasingly difficult as resources become more limited and livestock health declines (Kristjanson et al, 2014). Despite their vital contributions, women frequently lack financial and training support and have restricted access to decision-making. Women can be empowered to make more effective contributions to climate adaptation by supporting gender-sensitive climate policies and expanding their access to agricultural inputs, education, and extension services (Arshad et al, 2013). This will ultimately increase the resilience of households and communities.

capacity building, focused climate adaption plans, and assistance from agricultural organizations (Bett et al, 2017). To protect rural agricultural systems from the negative consequences of climate change, it is crucial to increase local awareness, encourage climate-resilient farming practices, and guarantee resource availability.

This study emphasizes how agriculture and cattle in Pakistan's Layyah district are significantly impacted by climate change (Khan et al, 2008). Crop productivity and livestock health have been impacted by rising temperatures, erratic rainfall, floods, droughts, and pest outbreaks, according to farmers (Bekele, 2017). While some respondents attributed their awareness to sociocultural or religious influences, about 81% of respondents acknowledged climate change as the main source of these disruptions (Raza et al, 2024). Many farmers use media outlets including radio, television, and newspapers to stay up to date on environmental developments, even when they have little formal education. Their findings highlight the urgent need for focused instruction and useful assistance to increase resistance to climate-related risks.

The study highlights the critical role women play in managing animals, including feeding, milking, cleaning, and gathering fodder, in addition to agricultural production (Awan et al, 2021). However, their duties frequently result in limited decision-making authority and health issues. Promoting

gender-inclusive practices and enhancing environmental education are necessary to overcome these problems (Naz et al, 2022; Amin et al, 2010). Climate-resilient farming practices, financial subsidies, and the provision of sufficient agricultural inputs are all examples of adaptive responses that are crucial. Farmers will be better equipped to handle present and upcoming climate issues if their capacity is strengthened via resources and knowledge.

Recommendations

To help farmers adjust to shifting climatic conditions, it is advised that specific climate-resilient agricultural programs be created in light of the findings. These ought to include training in climate-smart farming practices, encouraging the use of crop varieties resistant to heat and drought, and providing fast and accurate climate information. To lessen the effects of floods and droughts, efforts should also concentrate on building infrastructure, bolstering local extension services, and improving water management techniques. By acknowledging their importance in livestock management and giving them access to resources, training, and decision-making platforms, special attention must be paid to empowering women. To create long-term resilience in rural farming communities, policymakers and development organisations should embrace inclusive, community-based strategies that combine scientific methods with traditional wisdom.

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