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RESEARCH PAPER

# Climate Change: Threats to Agricultural Sustainability in Pakistan

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**ABSTRACT**

This paper explores to evaluate how Pakistan's agriculture is affected by climate change and to find techniques to mitigate and adapt to the changes. Pakistan's agriculture industry is drastically affected by climate change. The continuous inclination of temperature, shifting weather patterns, and more frequent climate change events are remarkably reducing crop yields, compromising food security and posing serious threats to rural livelihood. In order to evaluate the effects of climate change on agricultural output, water resources, and controlling pests, this study sought farmers in liable areas, reviewed a variety of literature in detail, and examined climate data. The paper also founds critical declines in crop yields, changes in developing seasons, and expanded irritation and sickness pressure. Farmers were observed using more groundwater, which resulted in a shortage of water and less fertile land. Pakistan needs to prioritize climate-resilient agricultural techniques, raise farmer awareness and capacity building, improve water management, and encourage crop variety to ensure agricultural sustainability.

**KEYWORDS** Agriculture Adaptation, Climate Trends, Farming, Policy Objectives, Sustainable Practices

## Introduction:

The effects of climate change have become increasingly apparent over the past decades (Patt and Schröter, 2008). Climate change refers to the significant and long lasting alterations to the earth's climate pattern over an extended period of time. It includes changes in temperature, precipitation, wind patterns and other aspects of weather on a global scale. Ozone harming substance discharges (GHG) from the broad utilization of non-renewable energy sources is probably the main source because of its impact on holding the heat in upper climate (Afzal, et. al., 2020). This climb in the worldwide high temperature enhances the dangerous atmospheric deviation peculiarity and compels the whole world to sense the environmental impact.

Climate change projections suggest a more variable climate with higher vulnerabilities in lower income countries (Easterling et al., 2000, McCarthy, 2001). Pakistan is a horticulture-based country, giving work to right around 25 million individuals. Like other developing countries, Pakistan seems particularly defenseless against the rapidly changing environment and has been positioned as the fifth most weak country on the planet to environmental change, even though Pakistan produces less than 1% of the world's carbon footprint. Owing to the climbing temperatures, Pakistan encountered a prominent change in rainstorm design and expanded event of cyclones throughout recent years with effects on the farming area. Like Pakistan expands its populace and corresponding development, these environmental alteration effects will leave crumbling impacts on the already overburdened economy. In addition, Pakistan is

the sixth most elevated populated country on the planet with a yearly populace increment of around 2%.

Right now, basically all-arable land in the Pakistan is a work in progress as the nation endeavors to encounter the reasonable food safety edge for the quickly developing populace. Environmental change has expanded temperatures bringing about unexpected changes in precipitation designs, which are firmly connected to agrarian creation and water assets. Precipitation power has changed radically as confirmed by extreme dry season and crushing floods that harm rich grounds along with foundation. Comparable most nations subject to the arable food creation in environments, Pakistan requirements to create and embrace environment savvy crops to accomplish food security. Essentially, a top strategy should carry out the environmental change moderation systems (zahid and rasul,2011).

Environmental change is influencing precipitation and shapes the fact that how much yearly precipitation will be. Several parts of the nation are getting under 250 mm precipitation for every year that requires further upgrade of cultivating and water system foundation including water system channels, trenches, and dams for water capacity. Water protection estimates should be carried out as well as utilizing the best innovations to store water. Domesticated animals contribute around 41% of the ozone depleting substances outflow in Pakistan. This fact proposes that new and high level cautions to be carried out by taking care of advancements, changes in creature feed arrangement, better and more proficient domesticated animals breeds, further developed fertilizer the executives rehearses, and the administration of field and munching area will be favorable in upgrading the farming proficiency as well as growing the potential soil carbon sink (syed et al., 2022).

Pakistan is among the most pompous regions connected with the variety in climatic occasions. Floods and dry spells are the first reason for monetary and social dangers for the people among different normal dangers to which individuals are uncovered and contribute heightening to mortalities. Especially, in non-industrial nations, rustic occupants are frequently powerless to floods attributable to the little versatile capacity and assets. The strength and brutality of flood occasions in emerging nations are for the most part connected with the natural and climatic vacillations. In the event that the proficient recognizable proof of the impacts of varieties in climatic circumstances on cultivating frameworks isn't completed expertly, it could especially and unfavorably influence the food efficiency and its wellbeing and furthermore it very well may be an obstacle in the efforts for declining of neediness and supportable turn of events. Pakistan is an agrarian nation, where in general contribution of farming area in Gross domestic product is 21.9% and straightforwardly or by implication utilizes 45% of the nation's all out workforce, comprising of around 60% of the provincial occupants; accordingly, any unfavorable result of climatic activities could impact their livelihoods (fahad & wang, 2020).

**Literature Review**

In this century, human race is confronting a serious danger as environmental change which has subverted the endurance of human development. In least difficult structure, climate change is the peculiarity by which atmospheric changes happen which leads towards shifts in the worldwide ecological and biological circles through slow but regular cycles. Environmental change is brought about by normal as well as by men made exercises. The poisnous gases (methane, CO2, and nitrous oxides and so on) are

radiated by individuals through different homegrown, business, and modern exercises (shahid & adnan,2021).

Pakistan's farming area assumes a crucial part in the nation's economy, utilizing a critical piece of the populace and contributing considerably to Gross domestic product. Notwithstanding, the area faces various difficulties, chief among them being the effect of environmental change. Lately, Pakistan has encountered a scope of environment related peculiarities, including whimsical rainstorm, frosty softening, and outrageous climate occasions, all of which have significant ramifications for farming. Agribusiness is one of the principal environment extreme financial sections that is impacted both decidedly and adversely by environmental change. Horticulture is the backbone of Pakistan's economy. It contributes 21% to the Gross domestic product of the state. Almost 67% of the populace is connected straightforwardly or in a roundabout way with horticulture. Agriculture is the vocation of a larger part of rural networks, however it is ordered as an unsafe occupation. Varieties in temperature or precipitation produce significant variety in crop result and yields. It is advantageous to specify that Pakistan offers short of what one percent of worldwide ozone harming substance (GHGs) emanations, however it is one of the most presented to environmental change influences. Moreover, Pakistan has an inadequate specialized and monetary ability to change in accordance with these unfavorable effects. Because of its agrarian economy, environmental change is turning into a difficult issue. Pakistan has the world's biggest water system framework and the significant water hotspot for it is snow and frosty liquefy. Environmental change isn't just undermining the water system framework because of quick dissolving ice sheets, yet additionally expands the gamble of floods, dry seasons, avalanches, power deficiencies, and torrential slides. It is a consistently mounting worry with limitless significance inferable from its articulated, extensive financial impacts. Variety in temperature and precipitation designs is an exceptionally terrifying issue in the yield area, particularly the parched zone (Baig &straqadine, 2021). Environmental change represents a huge danger to rural supportability in Pakistan, compromising the country's food security and the vocations of millions of ranchers (Hussain et al., 2020). Pakistan's agrarian area is profoundly defenseless against environmental change because of its reliance on precipitation, restricted water system foundation, and lacking environment variation measures (Qureshi and Ashraf, 2019). Climbing temperatures, adjusted precipitation designs, and expanded recurrence of outrageous climate occasions are projected to deteriorate in the next few decades, further worsening the difficulties faced by Pakistani ranchers (Ahmed et al., 2019).

Farming is the foundation of Pakistan's economy, utilizing almost 40% of the workforce and contributing essentially to Gross domestic product (World Bank, 2020). In any case, environmental change is supposed to decrease crop yields, adjust developing seasons, and shift reasonable trimming regions, prompting huge financial misfortunes and food uncertainty. Additionally, environmental change will likewise modify the dissemination and predominance of yield nuisances and sicknesses, further undermining horticultural efficiency (jatoi et al., 2023).

The effects of environmental change on Pakistani agribusiness are broad, with ramifications for rancher jobs, food accessibility, and public safety. Subsequently, it is fundamental to comprehend the dangers presented by environmental change to horticultural manageability in Pakistan and investigate methodologies for relief and variation.

## Material and Methods

In this paper, a blended technique research approach was taken on to completely research the dangers presented by environmental change to farming maintainability in Pakistan. This approach took into account the combination of both quantitative information on environmental change patterns and subjective bits of knowledge into farmer's' points of view and transformation methodologies. The examination configuration included a blend of essential information assortment through overviews and meetings, alongside optional information acquired from administrative reports, scholarly papers, and strategy records. A purposive testing strategy was utilized to choose members addressing different partners, including ranchers, horticultural specialists, and policymakers. Quantitative information investigation included spellbinding insights to inspect environmental change designs and their effects on horticultural efficiency, while subjective information was dissected utilizing topical examination to distinguish normal subjects and examples in ranchers' transformation rehearses. By locating information from different sources, this study pointed to give a thorough comprehension of the difficulties faced by Pakistani farming with regards to environmental change and to offer experiences for improving agrarian flexibility and manageability.

## Results and Discussions

The results show a clear impact of climate change on the survival of horticulture, with rising temperatures and varied precipitation precedents causing a sharp decline in crop yields (up to 20% in some districts). The analysis covers the wide-ranging effects of these shifts, such as raised frequency and severity of extreme weather conditions, polluted land, scarcity of water, and shifting seasonal patterns. The findings further highlight the increasing effects of climate change on pests and disease pressure, consequently weakening crop resilience. These results emphasize how important it is to have proactive transformation processes, environmentally sound agricultural methods, and strategy support in order to mitigate the negative consequences of environmental change on food security and agricultural production. The results of the study highlight the fundamentals of an organized plan to counter this existential threat.

## Impacts of Climate change on Agriculture in Pakistan

Pakistan being a warm territory, overwhelmingly in danger of barometric shift because of its placement in such geological locale where temperature increases higher than the wide-reaching. The terrestrial is for the most part parched and semi-bone-dry (around 60% of the zone gets under 250 mm of downpour for every annum and 24% gets between the 250-500 mm); the waterways are fundamentally delivered by the ice sheets of the Hindu Kush, Karakoram and Himalayan. Owing to the dangerous atmospheric devation, they are lessening quickly; the economy is agrarian and hence very powerless. If the precautions are not firmly placed, then there are huge chances that Pakistan will be confronting step by step greater hazards of irregularity in rainstorm in coming years. It will automatically determine how much precipitation consistently causing extraordinary floods and broad dry seasons. Based of the above factors, Pakistan's horticultural sector, energy security, flood security, and water security are seriously affected. (Abid et al., 2016). In Pakistan, farming is the prime monetary area that upholds around 45% of the nation's laborers, adds 21% to nation's Gross domestic product (GDP), and pays practically 60% to the country sends out. An estimation, Pakistan has around 23.4 million hectares under development, and 18.63 Mha just inundated. Water system is vital to Pakistan with 77% of the area in Punjab flooded with lesser sums in different territories.

Various cultivating frameworks exist including spate water system Spate water system is a harvest water system method that comprises of redirecting occasional tempest water from the streams, valleys, ravines, and river bottom by gravity onto agricultural land arranged at a subordinate rise than the floodwater (Barnett et al., 2014).

**Water Scarcity**

Water shortage is a critical worry in Pakistan, and environmental change worsens this issue (Khan et. al. 2022 & Khoso et al., 2015). Changes in precipitation designs and expanded vanishing because of hotter temperatures lessen water accessibility for the water system. This shortage influences crop efficiency, domesticated animals creation, and agrarian efficiency. Flooding and soil salinization additionally become more regular, lessening soil ripeness and yield efficiency.

**Irregular Temperature**

Temperature increment is one of the main effects of environmental change on agriculture in Pakistan. The typical temperature climb in Pakistan somewhere in the timeline of 1961 and 2010 was 1°C, and this pattern is projected to proceed, with temperatures expected to ascend by another 1.5°C to 2.5°C by 2050. This warming pattern influences crop development, efficiency, and reasonableness, prompting changes in developing seasons, crop cycles, and water prerequisites. Heat pressure, which happens when temperatures surpass 35°C, additionally turns out to be more regular and drawn out, lessening crop development and efficiency.

**Precipitation Impacts**

Changes in precipitation designs are one more critical effect of environmental change on farming in Pakistan. Winter precipitation (December to February) has diminished, while summer precipitation (June to August) has expanded. This modified precipitation design influences crop water necessities, soil dampness, and water system needs, prompting dry seasons or floods. Outrageous climate occasions like weighty precipitation and dry seasons become more successive, causing soil disintegration, land debasement, and harm to yields and framework.

**Extreme Weather Events**

Extreme heat waves and delayed dry seasons lead to trim disappointment and decreased yields. Whimsical and erratic storm downpours disturb planting and reaping seasons. Consistently, the discernment is getting genuine that environmental change is a reality; subsequently, leaders should be at monitors. Pakistan is no special case for the rising effects of environmental change, which is becoming apparent each spending day. The expanded recurrence and power of floods and late outrageous intensity wave occasions ought to act as a stunner to specialists. Nonetheless, notwithstanding laying out catastrophe to the executives specialists at the public and commonplace levels, Pakistan has been not able to appropriately enhance the effects of disasters (Shahzad and Amjad,2022).

**Soil Degradation**

Low gradation and salinization of soil because of expanded temperatures and sporadic precipitation is one of the main hurdle in agricultural sustainability. Loss of soil ripeness and efficiency is greatly influencing crop yields and food security. Environmental change influences soil wellbeing and ripeness in Pakistan. Climbing

temperatures and changed precipitation designs lead to soil disintegration, supplement exhaustion, and decreased water-holding limit. This resulted in diminished crop yields, decreased soil carbon sequestration, and expanded ozone harming substance emanations.

**Crop Yield Variablity**

Fluctuating temperatures and precipitation designs bring about conflicting harvest yields. Unpredictable climate occasions make it challenging for ranchers to really design and deal with their yields. Environmental change essentially influences crop yields, development stages, and appropriateness in Pakistan. Wheat, maize, and rice yields are projected to decline by 10-20%, 15-30%, and 5-15%, individually, by 2050. The alteration in the temperature and precipitation pattern automatically fine tune the crop span and determine how much water is necessary for the said crop. This marks the vulnerability of the yield against harsh weather and floods.

**Food Insecurity**

The continuous decline in the outcome of a crop and least efficient practices contribute towards undersupply of food marked with high prices. Owing to this fluctuation, the vulnerable community of the country will have to bear the brunt in the shape of deteriorating health and hunger situations. Food security in Pakistan is highly affected due to climate change in the form of declining harvest yields, shifting growing season and livestock productivity. This greatly influences the poor class in the form of reduced food availability, narrow access to nutritious food and inflation.

**Conclusion**

To cut the substance short, one can say that climate change poses drastic dangers to the agricultural sustainability in Pakistan. The farming sector of the country is highly vulnerable when it comes to the rising temperature, uncertainty in perception and outstanding climate events. These all factors contribute towards minimum by-products and disturb food security. The declining level of ground water and disturbed rain cycle give rise to a commendable threat for the cultivation. Soil degradation and continuous growing population of pests further diminish the efficiency of the results. These all facts add to the burden of an already vulnerable farming community.

It is very imperative for Pakistan to acquire modern and sustainable techniques in order to omit these issues. These techniques include the development of temperature resistant seeds, research to enhance soil health mechanisms and drought resistant crops to omit any misuse of ground level water. Educating and reinforcing the farmer class to new trends of farming is also very crucial for a sustainable future. Moreover, global agricultural practices and innovative methods in farming can save us from the atrocities of climate change.

By carrying out this action plan, Pakistan can omit any chances of further degradation in agriculture and simultaneously promising food security and creating a well-organized system for the population without any iota of damage from climate change. Seriousness in terms of effective policy initiation and implementation is very pivotal as it will be a decisive approach for the prosperity of the future generations to come.

**Recommendations**

Pakistan should strive to advocate climate resistance crop varieties. The country should try to put resources into innovative work of yield assortments that are impervious to dry spell, intensity, and vermin. This incorporates hereditarily changed crops and customary rearing methods to improve crop versatility. Energize the reception of environment brilliant farming practices, like protection culturing, agroforestry, and coordinated bother the board, to further develop soil wellbeing and increment crop yields. Furthermore, water conservation practices should be entertained from grass root level. Execute productive water system procedures, for example, dribble water system and water reaping. Advance approaches that help the manageable utilization of groundwater and surface water assets. Advance yield enhancement and intercropping to decrease reliance on a couple of harvests. This can upgrade flexibility to environment incited anxieties and market vacillations. Dispersing educational and vocational practices among the farmers play a crucial rule in achieving sustainable development pertaining to agriculture in Pakistan. By creating and dispersing exact weather conditions estimating and early admonition frameworks to assist farmers with settling on informed choices and make convenient moves to shield their harvests from outrageous climate occasions. Give preparing and instruction to agriculturists on manageable horticultural practices and environment transformation systems. Reinforce expansion administrations to connect the information hole among layman and specialists.

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