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KEYWORDS	ABSTRACT
Climate Change, Measurement Strategies, Sustainable Development Goals (SDGs), Developing Countries & Pakistan	<p>The climate change has significant environmental, economic and social consequences to developing nations, especially those with weak financial and institutional capacity. One of the countries in the world, which is most vulnerable to climate change, is Pakistan, despite its very small contribution to the amount of greenhouse gas emissions in the world. This study discusses the strategies of Pakistan to adapt to climate change, and concentrates on the sectoral remedies in the infrastructure, population health, disaster risk management, agriculture and water management. The results of the study show that a blend of ecosystem based, community driven and policy-based adaptation measures have been undertaken in Pakistan. There are efforts to increase the level of resilience and carbon sequestration in the ecosystems, and Billion Tree Tsunami Program is one of them. Still, issues of insufficient funding, poor institutional alignment, lack of data and disproportionate implementation across the provinces persist. It implies that, despite the important achievements made by Pakistan in terms of climate adaptation, resiliency in the long term requires continuous attention, advancement in technology, and international collaboration. The experience of Pakistan can be of the great benefit to other developing countries who are vulnerable to climate dangers.</p>
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INTRODUCTION

Precipitation occurs during the southwest summer monsoon between June and September, and the western weather disturbances during the months between December and March in northern and western parts of the southern. Approximately 60% of annual precipitation is caused by summer monsoon (Hussain, Chaudhary, Haider, Malik, Ali & Awan, 2022). The climate of the country is

arid and semiarid with an average of three-fourth of country getting less than 250 mm of rainfall each year, except in the southern Himalayan slopes and the sub mountain region of the northern part of the country that has a rain fall of between 760mm and 2,000mm annually. It is projected to be sixth-largest population in world by 2050 and average rate of population growth is projected annually with inefficient water management systems, placing further stress on limited resources. The population density is 231 people per km², & over 37% of people live in cities, with about 47% of them living in slums. The country now possesses second largest number of out of school children in the world with two-thirds of population being girls & one of highest fertility rates in Asia-Pacific region in general.

All the provinces southern sub regions are distinguished by a very high proportion of the severe poverty incidences compared to their northern ones except Khyber Pakhtunkhwa province which has a very high level of severe poverty incidences as well as north. The high level of poverty and inaccessibility of resources in Asian countries rank the country 146th of 187 countries in comparison to other South American countries, which are above the average human development index value. One of the nation's most susceptible to and at risk from climate change is Pakistan. The country has experienced many disastrous hurricanes, droughts and floods in the last couple of decades. Still, there has not been much research done on Pakistan's susceptibility and ability to adapt to threats associated with climate change. The farmers in the study districts reported that the primary adverse impacts of climate-related risks were water shortage, change in the crops growing schedules, and insecurity or reduced crop as well as livestock yield. The only benefit mentioned was increased agricultural yield. Farm households' ability to adapt is constrained by number of factors, including a lack of funds, information, resources, and institutional assistance (Abid, Schilling, Scheffran & Zulfqar, 2016).

There are several interrelated issues that impact climate change and poverty and food security, including the timing of extreme events, which are expected to become more common. With almost 300 million undernourished people, South Asia has the highest number of food insecure people. Nutritional factors can be incorporated into food security in terms of dietary diversity alongside the more popular measure of calorie availability. Climate-sensitive industries, like agriculture, are likely be affected by many of the effects of climate change (Ali & Erenstein, 2017). This study aims to examine significant environmental and developmental challenges as a result of climate change; the majority have many cause and effect dimensions. In addition, the nation is currently dealing with climate-related issues like significant glacial melt, lingering droughts and flooding cyclones, floods, and modifications to weather patterns and measurement strategies in developing contexts can be understood. The foundation of Pakistan economy, its agricultural output and water supplies, are being impacted (Sarfraz, 2016). An enabling environment that increases adaptive capability of vulnerable farming communities & works to reduce vulnerability is necessary for effective climate change adaptation.

The set of circumstances in which farmers work to improve their ability to adapt and pursue the sustainable livelihoods is referred to as enabling environment. Therefore, elements like information availability, markets, governance, local infrastructure, and finance availability are all part of an

enabling environment. Although, the resources are crucial for adaptation, they might not be used successfully without supporting laws in a suitable institutional setting, where "institutions" refers to public and private organizations. The vulnerability of developing countries is further intensified by rapid population growth, urbanization, and reliance on the natural resources for livelihoods. One important entity that can contribute significantly to adaptation management is the government. In Pakistan, climate change impacts are multidimensional, affecting agriculture, water resources, health, and infrastructure. It is commonly acknowledged that policies for adaptation must establish favorable circumstances that allow farming communities to adjust to climate change while offering decision-makers direction when preparing & carrying out adaptation initiatives (Nadeem, Jacobs & Cordell, 2024).

LITERATURE REVIEW

The most vulnerable nation in the world to severe weather conditions like droughts and floods is Pakistan. The hazards associated with climate variability and the adaptive strategies used by farm households to manage the negative shocks of natural disasters. Using a structured questionnaire, 600 respondents from 4-districts in Pakistan, Khyber Pakhtunkhwa province including Charsadda, Mardan, Nowshera, and Peshawar were gathered. Other research participants were also utilizing the several adaptation strategies such as changing the type and variety of crops, water storage, diversification of farms and altering seed quality, fertilizer and pesticides. To implement adaptation strategies to address the issue of climate variability, members of the study had to overcome several challenges. These included a lack of labor, an unstable land tenure system, a lack of market access, poverty, lack of government support, lack of access to assets, a lack of water sources, a lack of credit sources, and lack of information and knowledge. The study examines that primary causes of climate variability were variations in crop yields, crop diseases, water scarcity, and soil fertility loss (Fahad & Wang, 2018).

Climate change is a worldwide menace that has far-reaching impacts and Pakistan is particularly vulnerable to its impacts. Adaptation and mitigation of climate change in Pakistan using the latest technologies is important in helping to deal with numerous climate problems that Pakistan is faced with. The Quaid-e-Azam Solar Park and Green Line Bus Rapid Transit System are good examples of how well they can curb the impacts of climate change. An analysis of economic & environmental impact shows that the low costs and the absence of emissions of these technologies underscores the critical importance of these innovative technologies in protecting Pakistan against climate change and offer important insights into climate action globally. It examines the ways in which innovative technologies can contribute to the improvement of adaptive capacity and reliance on the Indus River system can contribute to susceptibility (Rasheed, Naseer, Abbas & Ahmad, 2023). Pakistan is predicted to suffer as a result of climate change. This is strange considering that the country stands at the position of 16th in climate change sensitivity and 135th in terms of the global greenhouse gas emissions per capita.

All facets of sustainable development are seriously threatened by climate change, which also has a significant impact on a wide range of ecosystems and sectors, including food, water, and energy; forests and biodiversity; the coastal and marine environment; and the frequency and severity of

climate-related disasters like drought and floods. It also bears the threat of confrontation, not only domestic, but foreign too that impacts of climate change in Pakistan adaptation and mitigation strategies, emphasizes the need to mainstream them into national development plans and policies, and clarifies the necessary elements that need to be included in the climate change action plan of Pakistan. This paper discusses the dangers of climate change because of the changes in the weather and adaptation in Pakistan (Khan, Khan, Ali, Ahmad & Ahmad, 2016). From 1994 to 2014, Pakistan experienced a high sensitivity index due to climate severe occurrences. Droughts, especially those that occurred amid 1998 and 2002, drastically affected cattle and agricultural productivity and compelled migration.

The Pakistan's economy is mostly based on agriculture, and the Framework for Implementation of Climate Change Policy (FICCP), 2014–2030, clearly focuses on adaptation measures to meet the challenges that climate change is expected to pose to Pakistan's diverse sectors both now and in the future. Climate change has made South Asia more susceptible overall, and Tran's boundary water problems are becoming more significant. The relationship between water and agriculture, post-18th amendment provincial coordination, the recently enacted Climate Change Act, Tran's boundary and riparian issues, the Sustainable Development Goals (SDGs) and Sendai Framework for Disaster Risk Reduction, and other factors have all been considered in this endeavor. This study examines the past strategies that adopted by the government to prevent climate change risk in south Asia (Khan, 2018). In this regard, the climate change poses the greatest threat to the Pakistan's cotton production, and achieving a sustainable yield is essential to meeting the nation's future needs. In many areas of the cotton-growing regions, the output of cotton is negatively impacted by climate change. It has a detrimental effect on farmers' socioeconomic circumstances and reduces both yield and quality of fiber.

A multidisciplinary modeling method combining climate, crop, and economics is being utilized to evaluate the diverse effects of climate change and build adaptation plans for sustainable cotton production (Ali, Tanoli, Bashir, Khan, Waseem, Wahab & Megersa, 2025). In this regard, globally, and particularly in the arid and dry regions like Pakistan, climate change scenarios showed rising maximum and minimum temperatures and unpredictable rainfall patterns. The cotton production systems that are climate resilient can reduce the adverse effects of climate change on cotton crops by establishing heat and drought resilient germ plasm, mitigating greenhouse gas emission through mitigation technology, implementing decision support systems (DSS) as well as utilizing ICT-based technologies to produce the cotton crop sustainably. The negative effects of climate change can be mitigated through the adaptation strategies and as such, changes to crop management (sowing, planting density, irrigation and plant protection) can be considered as good adaptation strategies to sustainable cotton production in the changing climate conditions of the world. Thus, this analysis will look at the way, the climate change initiatives the cultivation of cotton as well as crop fields (Rehman et al., 2020).

Urban populations and the environment are seriously threatened by today's rapid and unplanned urbanization. Urbanites from a variety of socioeconomic backgrounds may not have the knowledge or resources to adapt to climate change on their own in developing nations, that frequently struggle

to create eco-friendly cities due to lack of resources. Techniques used by Pakistan urban population to adapt to climate change. When urbanites' imprints are braced by exact data about temperature and precipitation patterns, they are more likely to employ adaptation measures that are available. Still, urbanite communities' resilience and ability to adapt can be severely diminished by a lack of resources. This study specifically aims to determine how the urbanites manage climate change and societal groups need assistance in addressing this problem (Ahmed & Luqman, 2024). Climate change has different effect on male and female farmers. These differences need to be understood to develop successful & fair adaption plans. Gender based disparities in high mountain farmers' views & adaptations to climate change in Pakistan Nagar District, offering information to guide focused policies and initiatives.

The data was collected through the standardized survey questionnaire reporting household level data on 430 randomly selected farmers. In general, there are no notable differences between male and female farmers' perceptions of climate change (Ali, Tanoli, Bashir, Khan, Waseem, Wahab & Megersa, 2025). Nonetheless, there are notable gender disparities in climate change adaptation, according to the independent sample t-test. The gender and climate change adaptability are also significantly correlated, according to the Chi-square test. The necessity for governments and non-governmental organizations to create the gender-responsive climate policies, integrate gender into climate adaptation plans, and put in place specialized assistance programs that cater to different adaptation requirements of the high mountain communities' male and female farmers. This study examines how each gender perceives and adapts to these changes in Pakistan, especially in high mountain regions (Ali, Shah, Alotaibi, Ali & Ali, 2025). Isolated mountain communities that rely heavily on the natural resources are extremely susceptible to environmental and climatic pressures, and relocation is sometimes most crucial livelihood diversification tactic for protecting a household from the shocks.

In-depth interviews, focus groups, and quantitative surveys were used to gather primary data at the household and community levels from 210 households spread over the six villages in the West Karakoram. Migration is structured by gender; women are left behind to handle household chores and agricultural work while men are the only ones who migrate in circular labor to metropolitan regions. This study evaluates how environmental shocks impact the migration and how remittances impact recipient households' ability to adjust and gender relations (Gioli, Khan, Bisht & Scheffran, 2014). One essential strategy for reducing climate change-related harm and safeguard livelihoods in underdeveloped nations is to integrate adaptation into the subsistence farming systems. Farmers claimed that climate change was causing an increase in pests and diseases and a loss in crop yield, according to a dataset of 450 farm households gathered from three Agro-ecological zones. Besides, the main actions taken by farmers include planting trees, altering crop varieties, sowing dates, and input combinations in the diverse situations. While private institutions provide weather forecasting services, community-based organizations primarily provide farmers with marketing information and farm equipment.

In the network study, public entities are not well represented. This study examines main obstacles to adaptation are a lack of resources, funds, and information (Abid et al., 2017). Water shortage, food

security, climate change & environmental sustainability have all grown to be significant worldwide issues. Consequently, increasing crop output requires increasing resource use efficiency. The crop models are becoming more and more popular as instruments to aid in tactical and strategic decision-making in a variety of Agro climatic and socioeconomic contexts. According to adaptation tactics, yield losses might be minimized if the crop were planted 14–21 days (for 2020–2050) earlier than the existing date, which is the last week of February. In Pakistan, adaptation measures are evident across multiple sectors, particularly in agriculture where farmers adjust cropping patterns, adopt drought-resistant seeds, diversify income sources, and implement improved irrigation techniques. These localized adaptations are essential because climate impacts are experienced most directly at the grassroots level. This study examines assessment of climate change & evaluation of adaptation plans to lessen its negative diverse effects (Nasim, Belhouchette, Ahmad, Rahman, Jabran, Ullah & Hoogenboom, 2016).

RESEARCH METHODOLOGY

The research was carried out by employing descriptive and analytical approach to proceed and draw the conclusion. For this purpose, qualitative method was used. All the data given in this study were composed from released papers in print media books, articles, journals, official reports of the organizations, experts available on internet for instance. In this linking, the secondary research on the research issues had referred and reviewed the Adaptation strategies of the climate change to developing countries.

RESULTS & DISCUSSION

The exiting literature on the climate change revealed that reducing vulnerability and increasing resilience to the negative impacts of climate change are the main goals of adaptation measures in developing nations. These nations' plans mainly focus on low-cost, community-based & sustainable methods because they often face increased risks as a result of their limited resources, inadequate infrastructure, as well as substantial reliance upon climate-sensitive industries (such as agriculture and fisheries).

Agriculture Policy Adopted by India

Although its percentage of the GDP has decreased from over 50% in the past, agriculture is still a significant sector of the Indian economy. Beginning in early 1950s to 14% in 2011–12 although it has been declining gradually, employment in agriculture now makes up 52% of nation's labor force. The notion of economic development is reliable with agriculture decreasing GDP and employment proportion. But in order to create jobs, raise incomes, and guarantee food security, the industry still needs to grow more quickly and sustainably. With 140 million hectares of net cultivated land, India is second only to the United States. India has the second-largest irrigated area in the world only surpassed by China. A large portion of India's land can be used for double cropping, since the nation is rich in natural resources and has a variety of climates. Over four-fifths of agricultural output has historically come from crop production, but in the last 20 years or so, things have drastically shifted. Livestock currently makes up almost 30% of all agricultural production, substantial increase from its previous share.

Evolution of Agricultural Policies

In India, agriculture has continued to be heavily regulated, with the parastatals and government organizations having significant impact on it. These both federal government & state governments implement regulatory regulations. However, the state governments still have constitutional control over the sector. India followed a program of food self-sufficiency in staple grains like rice and wheat after gaining independence. At first, strategies were concentrated on increasing the amount of land under cultivation, executing land reforms, developing communities & reorganizing rural financial institutions. Trade was tightly controlled by high tariff rates and quota limits. The primary measures of agricultural policy were adopted in mid 1960s. These included public storage, minimum support prices, input subsidies, food grain distribution and acquisition, as well as trade protection strategies. The returns of green revolt technologies lasted until mid-1980s, they diminished. With exclusion of lifting of export restrictions, India agricultural industry was mostly unaffected by a series of reforms implemented in the early 1990s, in contrast to other growing countries across the world (China & Brazil). Although agricultural reforms have been little, the macroeconomic reforms of 1990s had two significant effects.

Current Agricultural Policies

India's agricultural policymaking and implementation process is extremely intricate, including numerous ministries, agencies, and institutions at federal level as well as state level. The ministry of agriculture advised by planning commission gives the overall design of agricultural policies from different perspectives. The administration and execution of agricultural programs, still, continue to be under the purview of the individual state governments. The Planning Commission directs the distribution of agricultural funding, which are mostly distributed to several ministries within the Ministry of Agriculture. In this connection, the number of ministries, agencies, and organizations engaged in developing, carrying out, as well as overseeing agricultural policy is approximated (Arora, 2013).

Agricultural Policies Adopted by Bangladesh Government

A delta-land that connects to the Bay of Bengal is Bangladesh. It is known as a riverine country because hundreds of rivers flow from the Great Himalayas to Bay of Bengal, resembling the veins of the human body. The three principal waterways, Padma, Meghna, and Bangladesh's economy is centered on agriculture, with Jamuna constituting the Deltaic land. Because Bangladesh's soil was so fertile that it served as the primary draw for the production house in Greater India, the country's agricultural history was extensive and well-written in many books during the British era. In 1971, Bangladesh gained its independence following a nine-month liberation struggle against Pakistan. In this connection, Bangladesh's history is also reflected in its agriculture industry, which has seen the greatest ups and downs and continues to do so now the becomes nation most significant industry (Hasan, 2012).

Evolution of Agricultural Policy in Bangladesh

There are two phases to the development of agricultural policy: before and after independence. Here, a brief discussion of pre-independence will be followed by a more thorough discussion of the post-independence.

India's Policy Response to Water Resources and Climate Change

Focused on the policy response to the water and climate change challenge is Green India Mission and the National Water Mission as both are developed as part of National Action Plan on Climate Change. Other missions such as water industry of India are also greatly influenced by Himalayan Ecosystem Mission, the Urban Habitat Mission and Mission of Sustainable Agriculture. The Green India Mission identified key progress in managing the climate change issue that the India faces. It emphasizes the democratic decentralization, ecosystem services, forest quality, training a novel generation of young people in the community to be foresters, and using a landscape-based strategy to address the problem of water resources. A number of actions have been identified by National Water Mission as part of climate change action plan: Thorough public water database and analysis of how climate change is affecting water resources, Encouragement of state and citizen effort to preserve, increase, and conserve water, Preservation of wetlands, expanding storage, Concentrated attention on regions with excessive groundwater resource utilization, 20% increase in water-use efficiency and Encouragement of integrated water resources management at basin level (Kulkarni & Thakkar, 2012).

Resource Management Strategies of Bangladesh Government

Since the beginning of the ancient civilizations, which developed beside the major river systems in many nations, including the Egypt, India, and China, the value of water as a valuable resource for human nutrition and development has been widely acknowledged. The adage "water is the oil of the 21st century" is extensively used, yet it ignores the most important fact: unlike oil, water cannot replace living things. The hydrological cycles and ecosystems are recognized to be significantly impacted by rapid population increase and rising resource demand. Urbanization and other rapid land-use changes disrupt flow patterns and degrade water quality. In addition to being necessary for drinking, water is also essential for ecosystems, climatic systems, and the production of food and energy. Additionally, the demand for water is rising as a result of the socioeconomic development. Furthermore, growing environmental consciousness is driving up the ecological and environmental water demands.

Since 1947, there have been significant changes in Bangladesh's water governance, especially in the previous 30 years. The government of Bangladesh has been very interested and proactive in establishing water governance bodies as recommended by development partners. A critical aspect of climate change governance in developing countries is the measurement and evaluation of adaptation and mitigation strategies. In this regard, measuring climate change responses involves tracking emissions reductions, assessing vulnerability, and evaluating effectiveness of adaptation interventions. However, developing countries face significant challenges in this regard. A number of organizations, like the Bangladesh agricultural development corporation and the Bangladesh water development board, have assumed a significant role in water governance. Strengthening the governance structures, enhancing stakeholder participation, together with integrating the climate considerations into national development planning are critical for improving outcomes. The water research has taken a new direction with the universities and development partners in the forefront (Rehman, 2022).

Pakistan's Nationally Determined Contributions (NDCs)

The poorest individuals and those who are less resilient to climate shocks and stress basically, those who contributed the least to the crisis are disproportionately affected by climate change, which is a threat multiplier. When there are not sufficient resources to address climate change, low-income countries suffer more than developed ones. Despite making up only 0.9% of the world's greenhouse gas (GHG) emissions, Pakistan is among the nation's most at risk from the paraphernalia of climate change. The climate Change presents many difficulties and is increasingly posing an existential threat on global scale. Pakistan's experience with NBS to tackle global issues is useful as supplier of solutions. Intense flooding, abrupt changes in rainfall patterns, melting Himalayan glaciers, an upsurge in vector-borne illnesses like dengue, and a general rise in the frequency and severity of climate-related natural disasters are main manifestations of these effects. In addition to surpassing mitigation contribution, Pakistan has taken climate change action beyond Nationally Determined Contributions (NDCs) and implemented measures that helped reduce emissions by 8.7% between 2016 and 2018.

Pakistan national climate change vision is in line with sectorial agendas and national development plans. The National Climate Change Policy (NCCP) and Framework for its implementation serve as the foundation for this revised NDC. With a prominent role in climate change-related initiatives and programs in support of Paris Agreement, Pakistan is particularly vulnerable, as this document highlights. By implementing green development strategies and increasing mitigation efforts in the energy, transportation, land-use, land-use change, and forestry sectors (LULUCF), the GOP hopes to generate notable economic benefits and fiscal sustainability. In this linking, the ministries at the federal and provincial levels and departments have carried up a number of activities and projects linked to adaptation and mitigation that beyond the original NDC contributions fortification for realizing the desired outcomes. In conclusion, the case of Pakistan exemplifies the broader realities faced by developing countries in addressing climate change. These elements are highly valued in Pakistan and must be prioritized for the NDC to be implemented more successfully ([Government of Pakistan, 2021](#)).

Key Government Initiatives and Programs

The effects of climate change could be extensive, affecting not only the economy but also numerous other environmental and social facets of daily life. It is widely acknowledged that one of the unique challenges facing humanity today is climate change, which has profound effects on environment, the economy, and security. In recent years, Pakistan has experienced severe weather disasters such devastating floods, droughts & cyclones that have destroyed livelihoods, damaged infrastructure, and killed and displaced thousands of people. For instance, the 2010 mega flood alone destroyed 38,600 square kilometers and claimed 1,600 lives. In a similar vein, around 1,200 people died during June 2015 heat wave in Karachi. The possibility that these and other natural hazards may become frequent and severe in coming decades is increased by climate change into national development planning are critical for improving outcomes. Pakistan is among top ten nation's most vulnerable to consequences of climate change, according to that between 1999 and 2018, Pakistan experienced economic hardship of US\$3792.52 million, lost 0.53% of its GDP per unit, as well as observed 152 meteorological facts.

Asian Development Bank claims that environmental deterioration has significant socioeconomic implications, with annual climate adaptation requirements ranging from \$7 billion to \$14 billion. Aware of the problem, government is considering ways to lessen the destructive effects of climate change in Pakistan at the administrative, operational, and policy levels. One of the nations most impacted by climate change will be Pakistan. Due to severe water stress brought on by climate change, Pakistan will have to put up with food insecurity by lowering agricultural output. There are several elements that contribute to Pakistan's susceptibility to climate change that lessen the ability of its people, local organizations, and governments to adapt. The country's demographic trends, inadequate administration, slowly improving social standards, and increasing levels of environmental degradation are most notable of these causes. It is anticipated that Pakistan's various industries, including energy, health, agriculture, and others, be impacted directly and indirectly by climate change.

The Pakistani government encourages adaptation to the effects of climate change through both federal and provincial initiatives (Mari & Hussain, 2021). According to several studies, financing and governance remain main barriers to successful adaptation. Pakistan contributes very little to the world's greenhouse gas emissions, but it needs substantial international climate finance and technological assistance to address increasing rate of natural disasters. Institutional coordination between federal and provincial levels is lacking, leading to duplication of effort or underutilization of allocated funds. However, effectiveness of strategies depends on robust measurement systems, improved governance, substantial international support. Climate change in developing countries is not merely environmental issue but complex developmental challenge that requires integrated, multi-level & globally matched responses. So, building local competency, boosting transparency, and fortifying institutional frameworks are vital for the long-term adaptation (Ragavan, Marciel & Garg, 2020).

CONCLUSION

In conclusion, Pakistan offers an important example of both vulnerability and resiliency to serious and complex challenge that climate change poses to developing countries. Due to its geographic location, reliance on agriculture, rapid population growth, poor infrastructure, limited financial resources, Pakistan remains particularly vulnerable towards floods, droughts, heat waves, glacial melt, and water scarcity. The devastating floods of 2022 served as sobering reminder of how climate change has the potential to reverse years of development gains and worsen poverty and inequality. In this regard, the organizations like NDMA and provincial disaster management administrations have improved early warning systems and emergency response protocols. While these countries are vulnerable and resource-constrained, they are actively engaging in adaptation and mitigation efforts in their capacities. Yet, implementation gaps, lack of financing, problems with governance, and poor coordination amid federal and provincial levels continue to impede effective adaptation. Adaptability is vital for the sustained development and cannot be selected, as the Pakistan case study highlights.

The country has achieved significant progress through community-based adaptation programs, frameworks for the disaster risk reduction, climate-resilient agriculture initiatives, and national

policies like the National Climate Change Policy. The importance of international collaboration and climate funding is further highlighted by Pakistan's example. In spite of its small contribution to global greenhouse gas emissions, Pakistan emphasizes climate justice as a nation that has a major influence on climate change. Strengthening adaptation plans still depends on technology transfer access to the international climate funds and wealthy nations' support for the capacity-building. According to the findings, poor countries must adopt an integrated, multi-sectorial approach to effectively adapt to climate change. In this regard, improving the urban design, bolstering water management systems, investing in resilient infrastructure, raising public awareness, and promoting climate-smart agriculture are all crucial components. Local community participation, especially from the women and marginalized groups, is also decisive to ensuring the inclusive and sustainable adaptation outcomes.

Recommendations

These suggestions are based on this study. This study recommends the following recommendations to stakeholders:

Sustainable Water Resource Management

Managing water resources is major concern for Pakistan, as glacier melt, erratic rainfall & prolonged droughts are contributing to an increasing water shortage. Promoting efficient watering techniques like drip and sprinkler systems will significantly reduce water wastage in agriculture, sector that uses most water. By building small dams, rainwater collection systems, and improved groundwater recharge, it is possible to increase amount of water that can be stored and mitigate consequences of climate unpredictability. Coordinated watershed management, which includes afforestation and soil conservation, can improve groundwater recharge, reduce erosion, and reduce the chance of catastrophic floods.

Public Health Adaptation

Climate change poses a major threat to public health, mainly from heat-related illnesses & spread of vector-borne diseases like dengue and malaria. In vulnerable areas, strengthening healthcare infrastructure & disease surveillance systems is essential. Vulnerable populations can be protected by heat wave preparedness measures including public advisories and urban cooling infrastructure. Teaching medical personnel how to manage climate-sensitive medical states can boost resilience even more.

Climate-Smart Agriculture

Pakistani agriculture is still quite vulnerable to climate change; hence climate-smart agriculture is essential adaptation strategy. The development and spread of drought- and heat-tolerant crop varieties may reduce production losses caused by severe weather. The crop variety, improved soil management, and water-efficient practices should all be encouraged. Strengthening agricultural extension services help farmers make better decisions by providing them with real-time weather forecasts and climate advisory support. Expanding crop insurance programs & providing financial support to smallholder farmers will help safeguard rural livelihoods and encourage investment in flexible technology.

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